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THE TANTALUM LAMP.

Elsewhere we print an account of some interesting tests made in the electrical engineering laboratory of Harvard University on the new tantalum lamp. Owing to the nature of the resistance curve of the tantalum filament, an increase of voltage should affect it less than a carbon filament, and this is one of the conclusions of the test. The most interesting point, however, is with respect to comparative efficiency. Both the tantalum and carbon lamps had frosted globes, and under this condition the former gave a candle power on 4.3 watts, while the latter required only 2.2 watts, or but little more than one-half. The claims made for the new lamp with respect to efficiency are thus more than confirmed, and the electric lighting fraternity will await eagerly the results of life tests, upon which the future of the lamp now depends.

TELEPHONE RATES IN NEW YORK CITY.

Elsewhere we print in full a correspondence relating to reduction of telephone rates in New York City, from which it will be seen that after May 1 a much lower tariff will go in force on specified kinds of service, and that reductions are under consideration on other classes of service. Though the rearrangement of rates is coincident with a local agitation of telephone charges, the present action has been under consideration for some months and was probably little if any hastened by recent attacks on the Telephone Company. Moreover, the New York Company has been consistent in holding to a policy of reducing rates from time to time as the condition of its business warranted, and in the past reductions have been accorded at times when no claim of coercion could be made. From the letter of the Merchants' Association it appears that the Telephone Company freely opened its books to an investigation by a committee of that body, and some of the results of the scrutiny of the accounts are communicated in detail to the public in the letter which we reprint. There is no doubt that this statement will go far with men who are not professedly hostile in their attitude toward public service corporations.

There are indeed those who believe that the only real protection for such corporations from attacks menacing their existence lies in publicity of accounts, and this view is held in circles not at all antagonistic to public utility companies, and, in fact, has been put forth by some as a means of checking the growth of municipal ownership. The main difficulty in the application of the principle, however, is that the accounts published would in many cases not be properly interpreted. With respect to return on capital, due consideration would not be apt to be given to that part of the capital representing plant which, in order to keep step with progress, has had to be scrapped. The New York Telephone Company, for example, has practically gone through the scrapping process three times. Then, again, proper prudence in laying aside funds for future contingencies would be open to misconstruction on the part of the thoughtless. As a consequence of these and other considerations, the time does not yet appear ripe for the general application of the principle of publicity of accounts to such rapidly developed industries as telephony and electric lighting, which in many respects are yet in a stage of transition and calling for financial treatment entirely different from that which applies to a well-settled industry not subject to violent revolutions.

Bell Annual Telephone Report.

The annual report of President Fish, of the American Telephone & Telegraph Company, a condensation of which will be found elsewhere in this issue, shows that the remarkable growth of the Bell system, dating from about 1896, continues unabated. The increase during 1904 of instruments in the hands of Bell licensees was 701,047, or more than the total number at the beginning of 1896; while the increase of stations was 274,466, the total number of the earlier date being 281,695. The grand total of stations at the beginning of the present year was almost exactly 1,800,000, and the total wire mileage just short of 3,500,000 miles. In round numbers, the earnings for the year were $18,500,000, and the dividends paid $9,800,000, $586,000 being carried to reserves and $890,000 carried to surplus. The gross revenue increased over the previous year by $2,000,000 and the expenses by $1,290,000.

It will be noted that the great expansion of the Bell business dates from the time when the independent telephone movement became active. President Fish in his report refers to the favorable influence of this movement on the interest which he represents, saying that the presence of independent companies is not a substantial disadvantage to the Bell companies as a whole. Another point of interest in this connection is that the present rate of growth of the Bell company has been coincident with the invalidation or expiration of patents which, in the earlier and non-progressive period, gave it an absolute monopoly of the telephone field. In fact, it appears that in some cases the greatest benefit conferred by a patent comes at the expiration of its life, due to the necessity then created of energetically arming for battle in a competitive field. The incandescent lamp patent is another example to point, its invalidation having been closely followed by a great boom in the lamp business of the company to which it was supposed to accord a monopoly during its life. A significant paragraph of the report relates to so-called independent companies having relations with the Bell interests. The census report classified 84,021 telephones as being operated by independent companies on December 31, 1902. President Fish states that these were, in fact, Bell telephones used under contract with the Bell companies and as part of the Bell system; and that this number has grown so that on the first of January, 1905, there were 167,213 telephone stations of this class.

A Recovery of Waste Energy.

We are not aware that any serious attempt has ever been made to reckon up the amount of energy that is regularly wasted in manufacturing processes. That the aggregate is enormously great is certain, and that the major part of the loss is recoverable is altogether likely. But how much of this is economically recoverable under realizable conditions is quite another matter. To utilize either waste energy or waste material requires sometimes a combination of conditions not easily attainable. In many cases the waste can only be worked up on a rather large scale. In others operations on a large scale would be disastrous. An example of the former situation is often to be found in mining where certain tailings cannot well be treated with profit save in large quantities than are available. A type of the latter was presented some years ago in a proposition to produce electricity on a large scale from primary batteries in which copper was the element consumed and copper sulphate made a by-product of large value. One central station, of course, would initiate a bear market for copper sulphate and the scheme would fall of its own weight. Perhaps the most interesting recent attempt at recovery of waste energy is found in the use of waste blast furnace gases for the production of power by gas engines. A particularly interesting study of the work appeared in *Electrochemical and Metallurgical Industry* for March, which may be commended to our readers, both on account of its concrete importance and its value as a study of the principles of utilization of waste. Power production on a large scale is economically possible by this means, but under certain limiting conditions which form the real essence of the problem.

To begin with, about one-third to one-half of the thermal energy of the coke appears in the waste gases, and of this a good part should be recoverable—in theory enough to form a very valuable by-product of the industry. But as in every case of electrical power production, one must, for commercial success, have first a continuous supply of goods to deliver, and second, an available market. And since the goods are of a character not practicable to store on a large scale, the supply and demand must be coincident. The immediate result of the first condition is that only works having at least one furnace always in operation can undertake the saving at all. Practically that means that there must be at least three blast furnaces in the group, and several times this number to be certain of anything like a utilization of the whole surplus gas. Moreover, the plant cannot well be shut down altogether at any time, and hence must be kept in partial operation even during times of depression unless an auxiliary energy supply is provided. These requirements are less strenuous than appears at first thought. In the first place, there is so enormous and steady a demand for iron that plants must be kept running, and the last plant to shut down will be the one that most profitably utilizes its by-products. In the next place, even if the output be variable within rather wide limits, there is a market for cheap power on a considerable scale even when it is not absolutely permanent. For example, there are many hydraulic plants in which a good market is found not only for permanent power, but for secondary and even tertiary power, each subject to the claims of the preceding class. If a manufacturing plant can get power for nine or ten months in the year at a figure considerably below its own cost of production, it will pay to take it on.

The figures given in the article in question show very plainly that in a good many cases the waste gases can be profitably utilized for power production. Basing a computation of waste in tonnage of iron, it is shown that one can develop with existing gas engines more than 450 hp per ton of iron made per hour. A plant turning out 300 tons per day can, therefore, save between 5,000 and 6,000 hp in energy from what would otherwise be absolute waste. The cost of making this output is the cost of owning, maintaining and operating the gas engine plant with its accessories, and since such is the case, the cost of power depends even more upon the load factor than in the case of ordinary central stations. To get the best results the power sold should be, if possible, 24-hour power and a relatively steady load. Here lies the real difficulty of the situation. Perhaps a sub-station of such power could be most advantageously used by an electric railway or lighting system to good advantage, or even better, by a huge refrigeration plant. No one need longer raise a scare over the inequalities of load in such stations, for in fact some of the best load factors we know about in the electrical business are in railway plants. Certainly a few thousand kilowatts turned upon the bus-bars from outside at a cost below the plant's own cost of production would not be unwelcome. And from the figures given the blast furnace plant can turn out power very cheaply. With a load factor of 80 per cent. on 24-hour power, the total cost for a 6,000-kw plant of this kind, costing to build and equip $100 per kw capacity, is only reckoned at 0.44 cent per kw-

hour, allowing in this 5 per cent. on the investment and 8 per cent. to sinking fund for depreciation. This figure certainly allows sale at a good profit even to the ordinary large consumer, since the low figures often quoted for cost of power cover production alone and not fixed charges. At lower load factors the cost of power from the gas engines increases considerably, but whenever a good market can be obtained, there is an excellent chance for the profitable sale of power from this source. Gas engines are steadily undergoing improvement and the time is not far off when they will have to be reckoned with in more ways than this.

HARMONIC ANALYSIS.

It is remarkable how many branches of science involve harmonic analysis in their more intricate researches. Acoustics delights in curves representing composite tones or complex musical sounds, capable of being analyzed into simple tones and overtones—that is, capable of harmonic analysis. Heat indulges in similar vagaries, the cyclically fluctuating temperature in an underground vault being capable of analysis into annual and diurnal harmonic variations. Terrestrial magnetism enjoys similar analysis, in connection with the curves of magnetic perturbations. Tidal record curves bristle with similar possibilities, including solar terms and lunar terms. Mechanics is addicted to similar gymnastics in connection with curves recording vibrations of resilient systems. Astronomy delights to indulge in harmonic analysis in connection with variable stars, orbital relations, the excursions and deviations of the earth's polar axis and a variety of other problems. If chemistry has so far stood aloof from the intellectual bargain counter of harmonic analysis, it must be because her troubles have yet to come, for Nature is everywhere self-repeating, and the simplicity of circular motion, with its orthogonal projection, harmonic motion, is dear to her soul. The applied sciences naturally participate to some extent in the tribulations of the mother sciences, and dip into harmonic analysis more or less, but rather less. Electrical engineering yearns for it in theory and despises it in practice. Alternating-current waves are easiest understood, and perhaps also easiest produced, in simple harmonic form without overtones; but practically we seldom meet an alternating-current wave that is not as thickly covered with harmonic overtones or ripples, as a long-buffeted ocean-born log is covered with barnacles. There can be no doubt that the properties of alternating-current circuits can be more completely understood when the waves have been analyzed into fundamentals and overtones. In telephonic circuits the alternating-current waves must be crowded with overtones and the fundamentals might convey musical sound; but certainly could not convey intelligible speech.

For the purposes of accurate measurement, it becomes necessary occasionally to map the contour of an alternating-current wave, and to dissect it into its fundamental and its harmonics. It is a wonderful fact that any wave, however complicated, can always be analyzed theoretically into a fundamental sine wave and superposed harmonic ripple trains, all sine waves. One would suppose that by the use of free inspiration it would be practicable to draw a wave that could not possibly be capable of harmonic analysis; but the great Fourier forever deprived the human race of this hope. The means for resolving a curve into its equivalent harmonic components are of two kinds, algebraical and mechanical. The algebraical process contains a certain grim humor, because the process is usually endless. That is to say, there are, theoretically, an infinite number of harmonic ripple trains, and the secret of the tremendous scope of the analysis, applying as it does to every conceivable form of wave, lies in the endless number of ripple chains that have to be superposed, the wave lengths becoming shorter and shorter as the series advances. In practice alternating-current waves are seldom analyzed beyond the first two harmonics (of three and five times the fundamental frequency, respectively), while none seems to have carried the process for any alternating-current wave beyond the first eight harmonics, partly because the computer gets very tired at this stage, but mainly because the amplitude or size of the ripple usually diminishes as the series advances, so that beyond the eighth overtone the amplitudes usually become relatively microscopic. The mechanical methods of performing the analysis are, of course, much to be preferred to the algebraical, in so far as the machines do all the thinking and working out, after the specific problem has been assigned to them. On the other hand, they are delicate, complex, expensive and necessarily possess a certain mechanical play, backlash or small range of inaccuracy. Mechanical analyzers of great ingenuity have been worked out by Kelvin, Henrici, Coradi, Mailloux and others. These machines are luxuries and few persons can command such luxurious tools. They give swift and fairly sure results.

On page 587 of this issue, Mr. George H. Rowe describes a particular form of analyzer in the design of which he has employed the Yule principle. In effect, as described in the article, an Amsler planimeter is armed with an accessory plane, pointer and devices, whereby when the pointer is carried by hand over the contour of one complete wave, the planimeter records a certain total area proportional to the amplitude of the harmonic under investigation. The report given of the behavior of the machine when set to work on a simple straight saw-tooth wave of 45° inclination, as far as the ninth harmonic, shows that the errors are all below two-thirds of one per cent. of the fundamental amplitude. When a large number of alternating-current waves require to be analyzed, a mechanical analyzer of some kind is a welcome machine; but such analysis naturally falls to the lot of an unfavored few. It is the old story of the need of a gun in Texas. The need is rare, but when encountered, oppressive. In the usual case, where the analyzing machine is not forthcoming, it behooves the investigator to systematize the computation and to condense the work as far as possible. A number of methods for computation are known and available. Perhaps the simplest and shortest is that recently published by Prof. S. P. Thompson in the *Transactions* of the Physical Society (London). It is based upon the analytical method of Prof. C. Runge. By the practiced use of this method it would seem that two harmonics (up to the fifth order) can be evaluated in three minutes of computation, five harmonics (up to the eleventh order) in 25 minutes, and eight harmonics (up to the seventeenth order) in seventy minutes, the labor and time being thus roughly as the square of the number of harmonics sought. This method is capable of such rapid use when systematically carried out that it should be more generally known and utilized. It appears to be regularly employed in the technical courses of the Finsbury Technical College, regularly printed sheets being prepared in blank for the insertion of the computed products so as to systematize and abbreviate the work. The sheets are prepared for fifth-order and others for eleventh-order and seventeenth-order analysis. Telephony is woefully behindhand in alternating-current harmonic analysis. This is doubtless for the reason that the telephonic waves being so feeble, it is difficult to measure them at all, and yet more difficult to obtain a record of their contour. Nevertheless, if their contours could be obtained and analyzed, we might ascertain much more about music and musical instruments than we now know. It might be possible, for example, to determine the comparative musical value of voices or of pianofortes, by a harmonic analysis of their tonal qualities.

Annual Report of the American Bell Telephone Company.

The annual report of the American Bell Telephone Company, covering the year 1904, shows that on December 31, 1904, there were 4,480,564 instruments in the hands of Bell licensees, under rental, an increase of 701,047 over 1903, as compared with increases of 629,197 and 624,714 the two preceding years. The toll lines at the end of the year aggregated 136,547 miles, carrying 1,121,228 miles of wire. The lengths of lines for the two preceding years were 130,178 and 122,409 miles, respectively. The number of exchanges and branches in service were 4,080, the numbers for the two preceding years being 3,740 and 3,375, respectively. Following are further exchange statistics, with increases over the preceding year: Miles of wire overhead, 1,654,379, an increase of 296,239; miles of wire underground, 1,888,760, an increase of 270,069; miles of wire submarine, 6,671, an increase of 313; total miles of wire, 3,549,810, an increase of 566,621; total circuits, 930,251, an increase of 131,350; total employees, 59,451, an increase of 5,656; total stations, 1,799,633, an increase of 274,466.

Following is a comparative statement of earnings and expenses:

EARNINGS.

	1903.	1904
Dividends	$7,802,833.63	$8,400,301.18
Rental of instruments	3,047,088.35	3,438,605.54
Telephone traffic	4,888,158.34	5,575,447.90
Real estate	73,332.15	76,782.49
Interest	734,219.92	1,055,522.10
	$16,545,632.39	$18,546,659.21

EXPENSES.

Expenses of administration	$962,297.84	$1,103,492.95
Legal expenses	95,564.60	83,530.42
Interest and taxes	1,993,680.08	2,670,083.61
Telephone traffic	2,929,424.78	3,413,850.48
	$5,980,967.30	$7,270,957.46
Net revenue	$10,564,665.09	$11,275,701.75
Dividends paid	8,619,150.75	9,799,117.50
Balance	$1,945,514.34	$1,476,584.25
Carried to reserves	$728,139.97	$586,149.20
Carried to surplus	1,217,374.37	890,435.05
	$1,945,514.34	$1,476,584.25

Following are the ledger balances December 31, 1904:

DEBTORS.

Construction, equipment and supplies	$30,889,710.46
Telephones	7,301,688.70
Real estate	2,232,943.67
Stocks and bonds	138,684,248.03
Patent account	219,834.35
Machinery and tools	48,126.58
Cash and deposits	12,192,673.00
Bills and accounts receivable	35,140,047.95
American Bell Tel. Co.	22,110,400.00
Old Colony Trust Co.	25,000,000.00
	$273,819,672.74

CREDITORS.

Capital stock	$158,661,800.00
Surplus	5,601,099.65
Bonds	28,000,000.00
Bonds (collateral)	25,000,000.00
Notes	20,000,000.00
Reserves	8,726,614.94
Accounts payable	9,184,947.90
Contingent	18,645,210.25
	$273,819,672.74

The estimated number of exchange connections daily in the United States Bell exchanges, made up from actual count in most of the exchanges, was 11,149,063, or a yearly total of 3,589,998,000. The daily number of calls, which, of course, vary in different exchanges, averaged 62.

A curve showing the increase in the number of subscribers' stations indicates at a glance the remarkable growth of recent years, while in the 14 years, from 1882 to 1896, the number of stations only increased from 100,000 to about 275,000, a gain of 175,000; the increase in the eight years, from 1898 to 1905, was, in round numbers, from 400,000 to 1,800,000, a gain of 1,400,000. The net output of telephones during the year 1904 was 701,047, making the total in the hands of the operating companies 4,480,564. In addition to the 1,799,633 exchanges operated by companies constituting the Bell system, there were 167,213 exchange and toll stations operated by companies or associations under sublicense contracts and making use of our telephones. Adding also telephones employed for private line purpose the total of stations becomes 2,003,213.

The total amount added to construction and real estate by all the companies constituting the Bell system in the United States during the year 1904 was: For exchanges, $22,673,200; for toll lines, $8,243,500; for land and buildings, $2,520,000, making a total of $33,436,700. The amount added in 1900 was $31,619,100; in 1901, $31,005,400; in 1902, $37,336,500; and in 1903, $35,368,700, making the grand total of expenditure upon these properties during the five years, $168,766,400. The amount expended in 1904 for the construction, equipment and supplies required for long-distance lines was $4,012,905, making the total investment in long-distance lines and equipment up to the close of the year, $30,889,710.

President Fish, in referring to the business of the past year, states that the excess over any preceding year applies not only to the increase of the number of subscribers in established exchanges, but to the toll line development and the extension of lines and service into the more sparsely peopled sections of the different States.

The efficiency of the operating companies, he says, is constantly improving. The work of construction, maintenance and operating is done better and with more economy each year as improved equipment and more intelligent methods of construction, maintenance and operation are devised and introduced into use. Every extension of the service brings in new subscribers and, what is of greater moment, increases the value of the service to those already connected. The demand for telephonic connection has spread throughout the entire country, so that to-day not only the smaller householders and business men, but even the isolated farmers in all parts of the country are coming to regard the telephone as a necessity. Its use on railroads, in factories, on steamships and in other special environments is growing rapidly, and there is an enormous increase in the number of private branch exchanges in hotels, apartment houses and other large establishments where, by the use of the private branch exchange, the same telephones can be employed for intercommunication between the rooms or offices as well as to talk out upon the lines of the general system.

The service throughout the country is constantly improving, notwithstanding the enormously greater difficulty in carrying on the business on its present large scale. This is due in part to improvements in physical plant and to the adoption of better operating and maintenance methods, but even more to the more definite recognition that a high standard of service must be attained and to the more intelligent and careful supervision of the plant and of the operating which has come with experience and with a higher aspiration for good service.

Referring to the question of rates, President Fish says that the Bell companies are dealing with it intelligently and on sound lines. By the adoption of measured service in places where it is applicable, and of different grades of service which can be supplied at varying prices to meet the requirements of different classes of telephone users, they are promoting the necessary extension of the service on a basis that is safe and satisfactory both to the companies and to the public. As a fundamental principle the large user should pay to some extent in proportion to his use, while the smaller user should be offered a service adapted to his needs at a lower price.

The number of subscribers to the Bell system is now practically a hundred per cent. greater than was the case three years ago. In almost every part of the country each subscriber is able to talk to twice as many stations, and through those stations to a very much larger number of people. Thus the value of the service to the user is constantly increasing, and its cost to the subscribers, in relation to its value, is constantly reduced.

Moreover, the telephone users on the average pay a substantially less amount for the service they receive, irrespective of its increased value, than was the case three years ago. Not only are the standard rates reduced from time to time, wherever the conditions justify such a reduction, but a constantly increasing proportion of the telephones installed is furnished at the lower scale of rates adapted to the needs of those whose requirements are adequately met by the classes of service offered at such lower rates.

As a general principle it seems perfectly certain that it will always be the case that the larger and more densely populated the community, the higher must be the standard of rates for the comprehensive service required for that community. Not only the investment and the cost of operation, but the general difficulty of doing the business which can only be overcome by enlarged expenditure, increase in passing from the smaller towns and cities to the larger.

Referring to the effect of the operation of the so-called independent telephone companies upon the interests of the Bell companies, President Fish says that the developments of the year 1904

have served only to confirm the view heretofore expressed, that their presence in the field in certain portions of the country is not a matter of substantial disadvantage to the interests of the Bell companies as a whole. In some cases their competition, particularly in view of the rates at which they undertook to supply service, and which they themselves, to a large extent, now publicly acknowledge to have been entirely inadequate, has undoubtedly operated as an embarrassment to the logical progress of the business, and to that extent has interfered with its sound development, to the disadvantage, temporarily at least, of Bell interests, and clearly to the disadvantage of the public. It becomes more clear, however, every year that to enable the Bell companies to meet successfully such competition as may from time to time exist, it is only necessary for them to prosecute their affairs intelligently and with due regard to the public interest. The situation, as a whole, so far as this phase of the business is concerned, seems even more satisfactory than in former years. In many instances even aggressive competition has not substantially affected the sound application and development of the rates from time to time established by Bell companies as fair to them and to the public.

President Fish adds that the fact that the Bell company and allied companies constitute a national system extending throughout the country is, each year, more definitely recognized as entitling the Bell system as a public utility to a position which cannot be attained by rival organizations that are, relatively speaking, largely local in character. The number of telephone companies organized to operate independently of the Bell companies in rural districts and relatively small centers of population, and for the most part in places not at the time having the Bell service, which have concluded that it is for their interest to become a part of the Bell system, is constantly increasing, and their course in entering into contracts with the Bell companies, whereby they take their telephones and connect with toll lines of that system, is significant as showing the growing appreciation of the value of the Bell service. Such contracts are clearly for mutual advantage, as well as for the advantage of the community served, and are to be encouraged in the interest of sound telephone development, wherever, by reason of the establishment of such relations, it becomes unnecessary for our companies to duplicate an existing plant.

According to the bulletin of the Census Department relating to the telephone and telegraph industry of the United States, there were on December 31, 1902, of the telephones classified as operated by independent companies, so called, 84,021, which Mr. Fish states were in fact Bell telephones used under contract with the Bell companies and as part of the Bell system. This number has grown so that on the 1st of January, 1905, there were 167,213 telephone stations of this class. There is every reason to believe that this sublicense business of the Bell companies will increase from year to year to the advantage of all concerned.

The money required by the company for the extension of its long lines, and for investment in its operating companies for the year 1904, was obtained by the sale, on favorable terms, of $20,000,000 5 per cent. coupon notes, due May 1, 1907, and secured by its 4 per cent. collateral trust bonds to the amount of $25,000,000. The money required for like purposes for the year 1905 is provided by the sale, just consummated, of $25,000,000 4 per cent. collateral trust bonds.

Convention of Iowa Telephone Association.

The annual meeting of the Iowa Telephone Association, held at the Chamberlain Hotel, Des Moines, March 14, was the largest and most successful ever held by the association. In his annual address, President J. C. Sullivan pointed out the importance of closer union among independent telephone men in Iowa, and advocated the necessity of supervision of the long-distance telephone system by the Interstate Commerce Commission or a similar board. He declared the Bell long-distance telephone rates to be outrageous. The convention voted to join the national association in order to secure the benefits and carry forward the work above mentioned.

Mr. C. H. Judson, of Council Bluffs, read a paper entitled "The Old Way and the New," in which he stated that mutual telephone systems had forced themselves to the front and cannot be touched by corporations. Their strength, he said, lies in their service and their touch with local conditions and ownership by local persons.

Mr. N. T. Guernsey, of Des Moines, read a paper on "The Iowa Assessment Law," in which he considered the legal phases of the taxation problem.

The election of officers resulted as follows: President, S. S. Lichty, of Vinton; vice-president, P. C. Holdoegel, of Rockwell City; secretary and treasurer, C. C. Deering, of Boone. Delegates to the next national convention—J. E. Shoemaker, of Waterloo; J. C. Thorne, of Fairfield; J. S. Bellamy, of Des Moines, and P. C. Holdoegel, of Rockwell City.

A banquet was held at the Chamberlain Hotel in the evening and was largely attended, many ladies being present.

The entire fourth floor of the hotel was given over to exhibits of telephone apparatus and many telephone and supply manufacturing companies were well represented, their displays forming a very attractive feature of the convention.

Legislative Investigation of New York City Public Lighting Situation.

The New York State Legislature has appointed a committee to investigate the lighting situation in New York City, which will begin sessions during the present week. The committee consists of Senator Frederick C. Stevens, chairman; Senators Grady and Page, and Assemblymen Palmer, Agnew, Apgar and Merritt. Senator Stevens was formerly president of the Potomac Electric Light Company and the United States Electric Light Company, of Washington, D. C. It is intended to expedite the work of the committee in order that it may report at the present session of the Legislature.

The chairman has stated that while the main purpose of the investigation is to look into the public gas and electric lighting situation, it might also give some attention to the matter of telephone rates. The inquiry resolution adopted by the Legislature, he said, also gave the committee full power to take up the matter of the conduits through which the wires of the telephone and telegraph companies are carried. He said that the investigation would be conducted on a business plan and the witnesses called would be persons able to tell about the cost of producing and supplying gas and electricity to the city. The committee has power to call for books and papers. It is rumored in the newspapers that Mayor McClellan will probably present his views before the committee relating to the municipal lighting plant and that Comptroller Grout will welcome an opportunity to give his views about lighting contracts.

Electrometallurgy of Iron and Steel.

At the March meeting of the New York Electrical Society, held March 15, the subjects of the evening were the electrometallurgy of iron and steel, which were treated by Dr. E. F. Roeber, editor of *Electrochemical and Metallurgical Industries*, and Dr. Paul L. T. Héroult, of La Praz, France, well known for his scientific researches and engineering work in electrochemistry and electrometallurgy.

In President Sprague's opening remarks he referred to some experiments he had made ten years ago with an induction furnace for steel making in New York City. These tests did not lead to any commercial result at that time. Dr. E. F. Roeber then gave an address on "Recent Developments in the Electrometallurgy of Iron and Steel." Dr. Roeber dealt mainly with the manufacture of fero-alloys in the electric furnace and discussed especially those, such as ferro-titanium, the manufacture of which requires a very high temperature that is not attainable in the blast furnace. For other alloys which are being made to some extent in the blast furnace (for instance ferro-silicon) the electric furnace has the advantage of rendering obtainable a high percentage alloy. Thus in the electric furnace ferro-silicon is made containing up to 75 per cent. silicon, while the usual blast furnace alloy contains only 15 per cent. silicon. The speaker pointed out the advantages resulting to the steel men from the use of high percentage alloys. He discussed at some length the different methods which are in use by different companies to produce alloys or metals free from carbon. A large number of alloys of considerable value were exhibited. Some of the most interesting specimens were recivd from the Goldschmidt Thermit Company, the Niagara Research Laboratories and the Roessler & Hasslacher Company.

The use of ferro-alloys in steel manufacture has brought about a

revolution in recent years in the manufacture of special steels, especially for high-speed tools, armor plates, etc. The speaker dealt with the refining of iron, discussing the use of very hard electrolytic iron deposits for steel facings, and described the work done by Burgess and Hambuechen in making absolutely pure iron by electrolysis on a large scale. A sample of Burgess' electrolytic iron was exhibited. Dr. Roeber referred to the work done in making special steels of crucible steel quality in the electric furnace, describing the induction furnace of Kjellin in Sweden and detailing the work done in this field here by E. A. Colby and Dr. Leonard Waldo. He also referred to the successful steel furnace of Héroult and closed with a brief reference to the still open question of the possibility of producing pig iron commercially from ores in the electric furnace.

Dr. Paul L. T. Héroult spoke on "Making and Refining Steel in the Electric Furnace." He described the construction of his furnace, in which two electrodes are used dipping into a slag on the top of the molten metal. The current enters through one electrode, passes through the slag and the bath, and passes out again through the slag and the other electrode. By varying his artificial slag he is able to remove all the usual harmful impurities, such as phosphorus and sulphur. The cost of power is insignificant and the cost of the whole treatment in the electric furnace is below 50 cents per ton of steel if molten steel (from the Bessemer converter or the open hearth furnace) is introduced into the electric furnace. Dr. Héroult did not predict a revolution in the general metallurgical methods of steel making, but foretold marked improvement in the quality of the steel used for various purposes. If the refining of steel can be carried out at a very low cost, there is no further reason why better qualities of steel should not be used for many purposes.

The discussion which followed was participated in by Messrs. J. T. Moorehead, E. Stütz, L. Ruhl, Drs. Leonard Waldo and C. A. Doremus. Dr. Doremus spoke especially on the reduction of pig iron from ores and pointed out that it is simply a question of the relative cost of electric power and fuel. He showed, however, that there are other considerations to be taken into acount, for instance, that it is not necessary to use a certain quality of coke in the electric furnace. Dr. Leonard Waldo gave some reminiscences of early electrometallurgical work done in this country, and spoke especially on Mr. Colby's and his own work with the induction furnace, which he said is quite alive not only in Sweden but in this country. Dr. Héroult, replying to several questions, thought that the induction furnace has a certain disadvantage in the difficulty of cleaning. It was found that while Kjellin gets very good steels, they are not always exactly the same grade.

Reduction of Telephone Charges in New York City.

The Merchants' Association of New York on March 22 issued a letter to its members transmitting a letter received from Mr. M. N. Bethel, first vice-president and manager of the New York Telephone Company, advising the association of a reduction of telephone rates. The letter of Mr. Bethel is as follows:

"I beg to advise you that at a meeting of our directors, held to-day, a revised schedule of rates for direct line business telephones in Manhattan was adopted, to take effect May 1 next. The principal items in the new and old schedules are as follows:

Number of Messages.	Old Schedules.	New Schedules.
600	$75	$60
1200	111	87
1800	141	111
2400	165	135
3000	183	159
3600	201	177
4500	228	204

"All direct-line business subscribers will be billed at the new rates from May 1, regardless of the rates named in their contracts.

"The schedule of toll rates between the several telephone districts in New York City has also been revised along the lines discussed at our recent conference. This revision will take effect at the first of the month following the next issue of the telephone directory.

"The other schedules are under consideration, and in revising them I shall, of course, give due weight to the suggestions which your committee has made. When the work is a little further advanced, I shall be glad to meet the committee for a further discussion."

The communication of the association to its members is as follows:

"Supplementing our circular letter of February 27, 1905, respecting the inquiry being made by the association into telephone service and rates in New York City, we are pleased to be able at this time to make a definite report of progress. The conferences of the committee with the officers of the telephone company having reached a point where it was conceded that the present rate of earnings warranted another substantial reduction in charges, the question of revising the schedules was then taken up. Because of the manner in which this association had approached the matter and dealt with it throughout, the company expressed its willingness to give careful consideration to any suggestions which the committee might make as to the form and method of making the reduction with respect to the several classes of its patrons, claiming, however, that as its duty was to the public as a whole and to all classes of its patrons, the ultimate decision as to the character and form of reductions, with respect to these various classes, must rest with the company.

"Your committee has believed that the rates paid by some classes of users should be reduced to a greater extent than those paid by other classes, while, perhaps, some rates should remain unchanged, or be only slightly modified.

"Because of the great variety of interests involved, and the complexity of the problem, your committee does not believe that a uniform reduction would be advisable, or in the public interest, even if it were possible to make the reduction in that manner. The revisions thus far made, as set forth in the letter from the company, are substantially in harmony with the suggestions of the committee respecting the schedules already dealt with.

"As affording the only proper test of reasonableness, the committee has given particular attention to an analysis of the financial accounts of the telephone company, including investment and operating accounts, and gross and net earnings, and it has been afforded every facility for verifying these accounts. While it appears that the profits of the company during a number of years past have been liberal, and probably greater than those ordinarily derived from more stable industries, they have been exaggerated and cannot properly be called extortionate or exorbitant. For the entire period covered by the examination the percentage of net earnings to capital actually invested did not exceed an average of 11 per cent. per year, but during 1904, the last year of the period, it had reached about 14 per cent. The amount of capital invested in plant used in rendering its telephone service has been verified by the committee from independent sources and found to be fair and reasonable. The revision now being made is with a view to bringing the net earnings of the company on capital actually invested in the plant used in rendering its telephone service to a basis of about 10 per cent. per annum, to provide a return on the investment and proper reserves for contingencies. This amount is considered reasonable.

"Further conferences are to be held, and, from time to time, as may seem proper, circular letters will be issued to our members in order that they may be kept advised. On completion of the work the committee will make a more general report covering the entire question."

Mr. Marconi on Wireless Telegraphy.

Mr. William Marconi delivered a lecture on "Wireless Telegraphy" at the Royal Institution, London, March 3. In the course of his remarks he said that the "interference" objection advanced against wireless telegraphy was equally applicable to line work, where several stations were on the same line. Improvements in methods of tuning had been made, but owing to pending applications for patents he could not disclose them. As far as he knew, it had not been found possible to actuate satisfactorily a recording instrument or relay by means of a self-restoring coherer or anti-coherer. It had also been his experience that these non-tapped coherers were far too deficient in reliability for regular commercial work, especially if placed in the hands of inexpert operators.

Referring to the magnetic detector, Mr. Marconi said: The adoption of this magnetic receiver was the means of bringing about a great improvement in the practical working conditions of wireless telegraphy, by making it possible to do away with the troublesome

adjustments necessary when using coherers, and also by considerably increasing the speed at which it is possible to receive, the speed depending solely on the ability of the individual operators. Thus a speed of over 30 words per minute has easily been attained.

It will be noted that Mr. Marconi's reference to "interference" is a rather serious admission if he is correctly reported. The sum and substance of it is that the air offers the equivalent of only one wire, and that only one station can use it at a time. Wires can be multiplied in number.

General Electric Single-Phase Railway.

The Bloomington, Pontiac & Joliet electric railway, which is equipped with the single-phase tracks and system of the General Electric Company, was put in operation March 13 with a single car running between Pontiac and Odell, a distance of 10.4 miles. The generator of the railway is located in the central station of the Pontiac Electric Light & Water Company, which is owned by the same interests that control the electric railway. It is intended to operate the whole line as far as Dwight at 3,000 volts without any feeders by simply connecting the power station at one end to two No. 2-0 trolley wires with which the road is equipped.

The trolley wires are hung from three 8-in. steel stranded catenary conductors from which they will be supported every 10 ft., though at present the supports are placed only every 100 ft. midway between the poles, which are 7 ft. from the center of the track, and are fitted with a wooden instead of an iron bracket. The trolley wires are supported 9 ft. 6 in. from the track, and the catenaries are insulated by Thomas insulators placed 10 in. apart, these insulators being secured on malleable iron pins with Portland cement. The trolley wire is supported by mechanical clips having bronze hooks, which latter slip over the catenary cable and are then hammered down so as to prevent them from coming loose.

Within the limits of Pontiac a side pole instead of bracket construction is used. Both the trolley wires and catenary cables are supported from span wires, the catenary spans, which are just above the trolley spans, being used for safety. Both the trolley and catenary strain insulators are of impregnated wood 24 in. long, similar to those on the Schenectady-Ballston line, on which the first General Electric single-phase equipment was made. Additional insulation is secured by porcelain insulators located at the pole to which the span wire is attached. The ordinary form of trolley pole and wheel is used, exceptional precautions being taken, however, to insulate the trolley base.

The cars are equipped with four 75-hp General Electric, 25-cycle, series compensated motors. Unlike the cars on the Schenectady-Ballston line, which operate on both direct and alternating current, the cars are equipped for alternating supply alone and with a method of control which varies the speed by varying the potential by means of a transformer.

A paper on this installation will be read before the American Institute of Electrical Engineers on March 24 by Mr. George A. Damon, managing engineer of the Arnold Company, which built the road.

Development of Telephony in New York City.

The New York *Sun* of last Sunday published an interesting article on the methods pursued by the New York Telephone Company in laying its plans for the care of the future growth of its business. The essential method is to forecast from time to time the probable population in the company's various telephone centers. These forecasts are scarcely less important to the successful operation of the business than the manufacture of telephones or the laying of wires, for upon their accuracy hinges the financial profit or loss of the company.

In order to lay out the system of subways properly, to locate the telephone central stations, to decide their number and size and to determine trunk line routes and cable crossings, it is necessary to forecast changes in the population likely to occur, not only in one, two or three years, but as far ahead as twenty years. For this reason the experts employed by the company have studied the development of New York in a way which has probably never been followed either in this country or abroad.

As a result the plans of the telephone company are now being made for the growth to be expected in periods as far ahead as 1925. The basis for most of its building operations now is a forecast for 1920, which was made by its experts in 1902. The company's chief engineer explained the methods by which the forecasters obtained their results.

We have found, as a rule, he said, that the most reliable statistics concerning the growth of American cities are those given in the reports of the United States Census Bureau, and in making our forecasts these reports have been carefully studied and the past growth of the different cities of the United States analyzed and compared with that of New York. In addition to this the growth of London, Paris, Berlin and Vienna has been compared with that which has taken place in the large cities of this country.

After referring to the methods adopted by the Government in estimating the population of cities each year since the last census, he continues: In making our forecasts we pay no attention to these figures, for the reason that the growth of New York is not analogous to the growth as a whole of these cities of over 25,000 population. New York has peculiarities of situation and of conditions. New York is not an average city.

In figuring out our 1920 forecast we decided to estimate the population of the territory within a radius of eighteen miles from City Hall, even though a considerable part of this territory lies outside the city limits, and for this reason: From the point of view which concerns the telephone company the growth of places like the Oranges, Montclair and Yonkers is practically a growth of New York, and the residents of outlying districts who do business in New York and use a telephone at either end of the line are the same as residents of New York City. In smaller places the city line includes most, if not all, of the population associated with the city limit, but in New York this is not the case.

Our calculations relative to the population within eighteen miles of City Hall produced these statistics: In 1870 it was 1,880,000; in 1880 2,450,000, an increase of 30 5/10 per cent.; in 1890 3,278,000, a gain of 33 8/10 per cent.; in 1900 4,538,000, a gain of 38 45/100 per cent.

In view of these statistics, and after consulting every available source of information, the telephone company made this forecast: Within New York City and within a radius of eighteen miles from the City Hall there will be by the year 1920 a population of 9,000,000. Our figures for Greater New York indicate a population of 5,900,000 by the year 1920.

These estimates do not, however, agree with those obtained when the method of forecasting used by the Census Bureau is applied to New York City and its suburbs, and according to which the population in 1920 within the eighteen-mile area would be 7,000,000 and in Greater New York 5,300,000.

The difference in the two forecasts represents a problem which the engineers of the telephone company must confront. They must decide the question whether to plan for a population of 7,000,000 or of 9,000,000. If plans are made for 9,000,000 and only a 7,000,000 growth is attained a big error will have been made. In that event the telephone plant would be excessively large for the volume of business to be carried on and enormous losses would be incurred.

On the other hand, if plans are made for 7,000,000 and a growth of 9,000,000 should be reached it would mean that the plant would not be sufficient to care for the business, necessitating a radical reconstruction and a wasteful expenditure of vast sums of money.

In view of the numerous fire-proof buildings and costly switchboard systems which must be provided for the different central office districts it is obvious that not only must the population be correctly forecasted, but also the number of persons who will require telephone service and their location. It is also necessary to predict with some degree of accuracy how many times a day these subscribers will be likely to call up the central office, and also the districts to which their calls will extend. In fact it is only by doing this that the trunk line equipment and subway system necessary to join the various offices can be planned.

To one who has not studied the subject it would seem an utter impossibility to meet with any degree of precision these questions, and many others even more refined and complicated. Nevertheless, so far a fair degree of accuracy has been possible.

In planning for the underground ducts which will be required between now and 1920 the engineers go into the matter exhaustively. They endeavor in all cases to put down at one time a number suffi-

cient to meet the ultimate requirements, and in this way avoid unnecessary disturbance of the street and needless expenditure of big sums of mony. Our undrground duct system has already been extended to such a degree that there are now 295,000 miles of telephone wires on Manhattan Island, representing 99 per cent. of the total wire mileage. In this respect the showing made in New York is far ahead of that made by any other city in the world.

Naturally, if life becomes intolerably uncomfortable in a city the growth of population will be checked. Therefore, in forecasting New York's population for 1920 the telephone engineers have carefully studied the effect upon the growth of the population of improved rapid transit and taken into consideration the opening of the Subway and of the Williamsburg Bridge, which they believe to be forerunners of many subways, bridges and tunnels.

By 1920 their calculations provide for 1,000,000 telephone stations in the eighteen-mile area and 600,000 telephones in use in Manhattan, as against the 130,000 now used.

In answer to a question as to the possibility of wireless telephony and its effect on present interests, the engineer said: So far as I can see there is no probability that any developments in wireless telephony will substantially affect our plans.

Whatever developments there may be in the matter of wireless telephony will be found, I think, to supplement the telephone system now being planned instead of displacing it.

Electric Traction at the New York Railroad Club.

The regular March meeting of the New York Railroad Club, held last Friday, was devoted to a continuation of the discussion on the paper by Mr. W. B. Potter on "Developments in Electric Traction," read at the January meeting of the club. Mr. N. W. Storer emphasized the point brought out by Mr. Potter that the third rail for conveying the current to a car or train, however successful it may have been in the past, does not fill all the requirements for heavy and high-speed work, lacking as it does certain requisites for meeting steam railroad conditions. It is an obstruction, and no matter how well it may be protected it will always introduce a dangerous element, particularly to the section gangs engaged in track maintenance work. Mr. Storer agreed that a conservative attitude should be taken with respect to the introduction of electric traction on steam railroads. Whatever the limitations of the present steam locomotive, it is doing its work and doing it well, and any proposed change looking to its retirement must receive careful consideration from every point of view. If electricity is to receive the attention it deserves from steam railroad men, the electrical engineer must be able to show economies in operation, particularly in the handling of suburban traffic.

As to the choice of electric traction systems, it seems to be well established that for suburban and terminal situations, where the traffic is very dense, as in the case of the New York Central lines at New York, the direct-current motor is the best choice; but direct current will not do on trunk lines where traffic is dense, owing to the cost of transforming and converting. For this long-distance, high-speed work, high-tension current must be used and alternating-current motors must be adopted. Polyphase current is not suitable for railway work because it requires complicated overhead conductors and because the characteristics of the three-phase motors are not such as to meet best the conditions, particularly in the matter of variations in speed. Single-phase distribution is indicated and there are several means for its application. One is to have motor-generator sets on the cars, but Mr. Storer considered this method not adapted because of the great additional weight that would be added to the car units, and it does not admit of multiple control. The method might do for slow-moving freight traffic, but not for high speeds, and it will scarcely be the final system. Mr. Storer concluded that about the only system available for trunk and branch line work is that of single-phase distribution with series-wound motors on the cars.

Mr. A. H. Armstrong expressed the opinion that the whole question of electrification of steam railroads was one of finance more than of engineering. The large manufacturing companies have been able for some time to furnish electric locomotives that will do the work required, but heretofore they have not been able to offer economies over the steam locomotive. The art has, however, now developed to a stage that will justify the electrical engineer in going before a steam railroad directorate and asking a consideration of a complete proposition for equipping their lines electrically, in part or in whole. In making the decision as to the choice of generating and distributing methods, each section of a large system should be considered by itself as well as in relation to the whole problem. For example, a section comprising a long heavy grade may introduce specific factors. A road having a variable profile should have a motor that will give flexibility in varying speeds, whereas another road having a regular profile, whether it be a comparatively level or a continuous grade, will find the three-phase system feasible. Direct-current distribution in and around cities is so firmly fixed that it will undoubtedly be maintained. All three single-phase roads now in operation in this country are using the catenary overhead construction, which offers the possibility of carrying either two or three wires for single-phase or three-phase transmission.

Mr. J. C. Hubbell drew attention to the fact that although rapid strides are being made in the development of the electric motor, it must not be lost sight of that improvements will also be made in the present steam locomotive. He predicted that within five years steam locomotives would be in use capable of producing a horse-power-hour on 18 pounds of water, as against the present 22 pounds. In reply to a query, Mr. W. B. Potter stated that, of 4,500 indicated hp developed in the engines of the New York Central generators, 65 per cent., or about 3,000 hp, will be delivered at the rims of the locomotive drivers. This figure was obtained by taking the efficiency of the generator at 94 per cent.; of the transmission lines at 95 per cent.; of the sub-station apparatus at 90 per cent.; of the third rail at 90 per cent., and of the locomotive at 90 per cent. Mr. A. M. Waitt said he was convinced that the third rail would be the approved medium for conveying current for electric traction, for the reason that there is no room, especially in freight yards, for overhead wires with complicated crossing switches, etc. Mr. Frank J. Sprague said he believed that we have not yet reached the limit of direct-current distribution, and that it is possible to use direct current at much higher voltages than are now customary.

CURRENT NEWS AND NOTES.

RAILWAY MOTOR CONTROL.—A patent issued March 14 to Mr. C. P. Steinmetz relates to a control system applicable to certain types of railway motors, enabling them to be operated efficiently on either direct or alternating current. The motor used is of the compensated type, with field, compensating and armature windings, with means provided for connecting all three windings of the motor in series to the source of direct current or for connecting the compensating winding to the source of alternating current and short-circuiting the other two windings in series with each other. The system will be more fully described in the issue of next week.

TULOCA LIGHT AND POWER COMPANY.—A decision has just been rendered by Judge Davis, of Part IV of the Supreme Court of New York, in a litigation relating to the Tuloca Light & Power Company, which for about two years has been operating a 1,250-hp plant transmitting current at 25,000 volts from San Simonita Falls, Mexico, to Tuloca, 25 miles distant. The suit was an action brought to reform a contract and to enforce performance thereof, the parties to the suit being Messrs. Potter and Tuteur, plaintiffs, and C. L. Rossiter, defendant. The concession for the plant was the property of the plaintiffs, who made an agreement assigning to the defendant the concession for development as a light and power plant and turning over certain contracts for lighting and power. Among the payments specified were certain amounts of stock and bonds and a cash payment when the work of constructing the light and power plant would be done. The work of construction was to be under the sole charge of the plaintiffs, for which the defendant was to pay them $150,000 in gold. The plant was to be completed one year after the work started, and the defendant was to receive one-third of the profits realized from the work of construction. Various differences arose in carrying out the terms of the contract and the litigation just decided was the result. The court decided that the plaintiffs were entitled to the stock and bonds specified in the agreement and to $13,000 in cash, and also to an accounting to ascertain the profits rising out of the construction of the plant. Other minor awards were also made to the plaintiffs.

NEW MEXICAN CABLE.—A dispatch from the City of Mexico states that the Mexican Cable Company is about to lay a new submarine cable from Galveston to Coatzacoalcos, a distance of 800 miles.

BRAZILIAN CABLE CENSORSHIP.—The Commercial Cable Company has been advised that censorship has been raised from cable dispatches in plain language coming from Rio de Janeiro and Nichtheroy.

FREE ELECTRIC SIGNS.—The Edison Electric Illuminating Company, of Brooklyn, is offering to install electric signs, lettered to suit the user and including wiring, free of charge. The user only pays for the current.

UNVEILING CITY ELECTROLIERS.—Two big bronze electroliers in Longacre Square, New York City, were unveiled a few days ago. They were presented to the city by William C. Muschenheim and others. A large and representative party attended the unveiling ceremonies.

CHICAGO SUBWAY.—The investigation into the bribery charges against the Illinois Telegraph & Telephone Company ordinance has been discontinued because of the failure of T. P. Quinn and Charles Dold, the officials of the Federation of Labor, who made the charges, to substantiate their claims.

THE WASHINGTON AGRICULTURAL COLLEGE AND SCHOOL OF SCIENCE, Pullman, Wash., has been changed in name by the State Legislature, to State College of Washington. Large appropriations for the additional equipment of the department of mechanical and electrical engineering were made, and extensive additions to the equipment of the electrical laboratories will soon be put under way.

INTERNATIONAL ELECTRICAL CONGRESS.—The *Transactions* of the International Electrical Congress will probably be ready for issue to members and subscribers early in April. An arrangement has been made whereby those who so desire can have the volumes delivered to a firm of binders for binding at 20 cents per volume in cloth or 60 cents per volume in half-morocco. Otherwise, the volumes will be delivered in paper covers, carriage prepaid, to the address of the member.

COST OF ELECTRIC STREET RAILWAYS IN ENGLAND.—In a paper read at a recent meeting of the Tramways and Light Railways Association, the cost of building electric street railways in England per mile, single line, was stated to range from $19,000 to $29,000. The proportionate costs of the various kinds of work were figured as follows: For rails and fastenings, 22 per cent.; special work, 10 per cent.; paving material, 30 per cent.; cement, sand and broken stone, 14 per cent.; labor, 15 per cent.; bonds, cartage and miscellaneous items, 9 per cent.

CARING FOR TELEPHONE GIRLS.—The New York Telephone Company has given its operators notice that if they so desire they will be transferred, as far as possible, to exchanges near their homes and still hold their present rank, which, with the girls, is chief operator or a "what number" operator. Many of the girls who live in Harlem now have to travel downtown, and some who live downtown have to travel uptown to work. In the case of a snow blockade or a city railroad strike this has been hard for the girls and troublesome for the company.

TELEPHONY IN CANADA.—The Dominion Government has decided to take up the long-standing question of general legislation governing telephone systems. The Postmaster-General foreshadowed that the government would take over and operate the telephone systems in Canada, when offering the following resolution to the House: "That a select committee be appointed to inquire into and report regarding the various public telephone systems in operation in Canada, and elsewhere, as the committee shall determine; and to consider and report what changes, if any, are advisable in respect to the methods at present in force for furnishing telephone service to the public."

N. E. L. A. CONVENTION.—A large number of inquiries have been received by the National Electric Light Association regarding hotel accommodations at the twenty-eighth convention of the association, to be held at Denver-Colorado Springs, June 6-11 next. All such inquiries should be addressed to the Committee on Hotel Accommodations, 405 Seventeenth Street, Denver. The personnel of the committee includes Mr. W. J. Barker, chairman; Messrs. J. Hernan, J. J. Cooper, J. F. Vail, S. W. Cantril, H. L. Woolfenden, Philip Cross and J. C. Andrews, secretary.

ELECTRIC POWER FOR CANAL LOCKS.—Arrangements have been completed for the installation of electrical machinery to operate all the locks in the Lachine Canal, in Canada, and the entire new system will be in operation on the reopening of navigation this spring. Special power houses have already been completed at Montreal and vicinity. It is estimated that, with the electrical equipment, there will be a saving of slightly over five minutes at each lock. The plan of improvements for the different canals around Montreal, during the coming summer, will result in an outlay of nearly $400,000.

TELEPHONE DETECTION OF WINE ADULTERATION.—It is reported that the well-known chemist, Maneuvrier, at Paris, has made the discovery that adulteration of wine with water, other liquids, and with solids can be detected through the aid of the telephone. Two glasses, one filled with the wine to be tested and the other with a like quantity of wine known to be pure, are placed upon an apparatus resembling a scale and a telephone connected with both liquids. If both wines are pure no sound is heard in the receiver, but if one contains water a noise is produced until a pointer is moved to a given place on the dial plate, whose movement renders the conductivity of the liquids uniform. The gradation on the dial where the pointer stops shows the quantity of extraneous matter in the wine. This new application of the telephonic balance is interesting—if true.

ELECTRIC PLANT IN FORMOSA.—United States Consul Fisher, at Tamsui, Formosa, reports that in the early part of 1904 the engineering department of the Formosan Government commenced work on the construction of an electric plant on the upper course of the Shinten River, about 10 miles to the southeast of Taihoku. Just above the junction of Hokusei and Nansei Rivers, which form the Shinten, the course of the latter stream describes a reversed S, which may be used to illustrate the construction of the canal from the upper point of the figure to its center, where the water is brought to the opposite side of the river by means of syphon pipes, thence to the lower point of the figure to the site of the plant, where it will have a fall of about 50 ft. The length of the canal is 7,200 ft., which includes a tunnel of 220 ft., and 280 ft. of two-row syphon pipes, each 5 ft. in diameter. The width of the canal at the bottom is from 11 to 12 ft., and the discharge will be 250 cu. ft. per second. This is intended to give 1,000 horse-power, but 650 horse-power will be sufficient for the present requirements.

TIMOTEO BERTELLI.—An authority in early magnetic history has passed away in the person of Timoteo Bertelli, of Florence. He was born in 1826 at Bologna, his father being professor of astronomy in the university of that city. After the usual course of studies, he embraced the ecclesiastical career and became a member of the Barnabite Order. Having shown unusual aptitude for physical investigation, he was appointed to the chair of physics in the College de la Quercia, Florence, a position which he held for the greater part of his life. His published works include sixty memoirs on electricity, telegraphy, meteorology and seismic phenomena. That by which he is best known abroad is his memoir on Pierre de Maricourt *aliter* Petrus Peregrinus, which appeared in the *Bolletino di Bibliografia e di Storia delle Scienze Matematiche e Fisiche* for 1868. This lengthy memoir contains the text of the letter written by Peregrinus to a friend of his, the *Epistola ad Sigerum,* in which he sets forth in a systematic way the properties of the lodestone, many of which he himself had discovered. The *Epistola* is dated Nocera, 1269. The Wheeler collection in the library of the American Institute of Electrical Engineers, contains two copies of Bertelli's memoir, which is a marvelous piece of bibliographical research and judicious criticism.

MUNICIPAL PLANT FAILURE.—The municipal lighting plant at Rock Falls, Ill., is to be discontinued. It was a losing venture. The city lighting and other illumination will now be furnished by a private company.

MARCONI MARRIED.—A dispatch from London states that Mr. William Marconi was married March 16 to the Hon. Beatrice O'Brien, sister to Baron Inchiquin, in the Roman Catholic Church of St. George. The couple will spend part of their honeymoon in Ireland and sail for New York on March 25.

NEW YORK'S MUNICIPAL PLANTS.—The Board of Estimate has authorized the Comptroller of New York City to buy at private sale two sites for municipal lighting plants, one at Ninetieth Street and Avenue A for $350,000, and the other in Long Island City, at Vernon Avenue and West Avenue, for $200,000.

FRANCHISES IN NEW JERSEY.—The New Jersey Assembly, after a hard fight has adopted the committee substitute for the Colby limited franchise bill, providing for limited instead of perpetual franchises for trolley companies. The substitute provides for a commission to inquire into the subject and report to the next Legislature.

WESTERN UNION CODE IN THE NAVY.—It is stated that the Navy Department has officially adopted the Western Union telegraphic code and copies are to be placed on all the ships of the navy. Besides insuring secrecy of the department's official communications, the use of the code will materially reduce the cost of the telegraph service.

EUROPEAN TELEGRAPH SERVICE.—United States Consul Liefeld, at Freiburg, Germany, reports that in European telegraphic service Germany ranks fifth, with 67 messages to every 100 inhabitants. The countries which surpass Germany are England, 214; France, 114; the Netherlands, 78; and Switzerland, 72—messages each for every 100 residents.

COLUMBUS (O.) MUNICIPAL PLANT.—The Board of Public Service, of Columbus, Ohio, is installing a municipal plant for 1,800 series enclosed arc lights. The generating plant consists of three 400-kw, two-phase, 60-cycle Westinghouse turbo-generators. The condenser centrifugal pumps will be driven by induction motors. Western Electric 75-light constant-current transformers and arc lamps will be used.

ASSOCIATION OF ELECTRIC LIGHTING ENGINEERS OF NEW ENGLAND.—At the annual meeting of this association, held at the Parker House, Boston, March 15, the following officers were elected: President, Mr. S. W. Cowles, Boston (re-elected); vice-president, Mr. W. I. Barnes, Providence; secretary and treasurer, Mr. C. R. Brown, Boston (re-elected). Board of Directors—Messrs. A. I. Bliss, Malden; W. C. Woodward, Providence; W. T. Holmes, Newton; T. H. Mather, Portland; W. R. Tatan, Cambridge; George R. Stetson, New Bedford.

REGISTERING METER.—Two patents granted March 14 to Mr. C. H. Thordarson relate to means for enabling an operator at a central station to effect a record of the indications of integrating meters located at a distance from the central station, thus dispensing with the sevices of the inspector employed for reading the customer's meters. The complete system contemplates a recording mechanism for each meter and a single printing device for the central station, the latter being capable of being switched in circuit with each recording mechanism as desired. A make-and-break device is arranged to be operated by the customer's meter, and to set the recording mechanism according to the total number of breaks made by the meter. The printing device consists of a set of type wheels arranged similarly to those of a counting train and provided with ratchets operative by electromagnets energized according to the indication of the recording device at the customer's meter. A separate circuit must be run from each meter to the central station; a single printing device, however, is sufficient for any number of meters.

ELECTRICAL COMBINATIONS IN GERMANY.—Consul-General Guenther, of Frankfort, Germany, in a recent report, states that the seven principal electrical combinations in Germany have, with their affiliated financial and construction companies, a total capital of $109,106,000. Some of them have branches in Russia, Austria-Hungary, Switzerland, Italy, Spain, the Netherlands, and the Balkan States, which have given a strong impetus to Germany's electrical industries. These concerns have $34,500,000 mortgage loans standing against them, from which must be deducted $9,000,000, representing their accumulated reserves.

LEGISLATION AND ELECTRICAL INTERESTS.—The Northwestern Electrical Association keeps close track of all legislative matters affecting the interests of its members. All bills introduced into the Wisconsin State Legislature relating to electric lighting or railways are forwarded to members, who are asked to scan the bills and act should any be found prejudicial to the electrical interests. Up to February 18 there had been introduced a total of 32 bills, among which are the old-timers, requiring all electrical circuits to be placed underground, providing that every passenger shall have a seat in a street car, etc. A number of the bills are in the interest of municipal ownership.

NEW YORK LIGHTING BIDS.—Bids for city lighting were opened on March 17. They showed for the most part little or no alteration in the companies' prices. For the electric lighting of the streets of Manhattan the New York Edison Company asked, if more than 5,000 lamps were used, $140 a year for lamps supplied with power from underground wires, and $130 if overhead wires. If less than 5,000 lamps are used the old rate of $146 a lamp is asked for. The only competitor for Manhattan lighting was the United Electric Company, whose bids were the same as those of the Edison Company, except that a little more was asked for the illumination of street signs. Mayor McClellan has ordered that all the bids be rejected because they do not offer any material reduction in the prices.

CENTRAL STATION ADVERTISING.—The Denver Gas & Electric Company is always effective in its methods, whether these relate to the technical, managerial or advertising departments, and in fertility of ideas in the later department the average "ad-smith" is outclassed, both as to substance and to style. Among the latest productions is a very artistic card intended for presentation to housewives, and announcing a cooking lesson at the Company's office on a given date, during which instructions will also be offered in meter reading and the economical management of a gas range. Another card, sent out as a postal, is stamped in the form of a purse, on which is printed "You Won't Refuse to Fill It." Upon opening the folds one sees a half-tone engraving of a store front with electric signs and highly illuminated windows, with the inscription underneath, "Ask this man about his wallet." A sign above the store front identifies the firm, which doubtless is known locally to be highly prosperous.

A. I. E. E. MEETINGS.—The meeting of the American Institute of Electrical Engineers of April 28 will be devoted to the subject of instruments and measurements. Four papers are scheduled for this meeting as follows: "Polyphase Metering," by J. D. Nies; "Notes on the Use of Instruments on Switchboards," by F. P. Cox; "The Oscillograph and Its Uses," by L. T. Robinson; "Maintenance of Meters," by W. J. Mowbray. The meeting of May 16, 1905, which is also the annual meeting at which announcement of officers elected will be made, will have for its subject safety devices. The three papers scheduled for this meeting are as follows: "Relays," by G. F. Chellis; "Circuit-breakers and Oil Switches," by E. M. Hewlett; "The Proper Limits of Duplication to Secure Reliability of Service," by H. W. Buck. The annual convention will be held June 19 to 23, at Asheville, N. C. For this meeting the following partial list of papers is announced: "Appalachian Water Powers," by Dr. F. A. C. Perrine; "Coil Reactances," by D. B. Rushmore; "Limits of Injurious Sparking in Direct-Current Commutation," by Thorburn Reid; "Study in the Design of Induction Motors," by Prof. C. A. Adams; "Choice of Motors in Steam and Electric Practice," by William McClellan; "High-Potential Oscillations in Large Power Distribution Systems," by Dr. C. P. Steinmetz; "Investigations of the Destructive Strength of Air at Very High Voltages," by Dr. C. P. Steinmetz.

The Edison Electric Company's System in Southern California.—IV.

(*Concluded.*)

LOS ANGELES STATION NO. 2.

ONE pair of 15,000-volt feeders from the No. 3 station leads to Los Angeles Station No. 2, where the Edison three-wire distributing station is located. This station is placed right in the heart of the business district, on Fourth Street, and is being reconstructed so as to become the center of distribution of both alternating current and direct current for the whole city. All bus-bars will be in duplicate.

The distribution for the house-to-house overhead system in the residence portion of the city will be accomplished through the means of sub-stations scattered about the residence portion, supplied at 15,000 volts and distributing at 2,300 volts.

The local distribution in the business district is at 220 volts direct current for lighting and small power and 500 volts direct current for larger power units. This is accomplished through four units for the 220 volts, and through three units for the 500 volts, each unit being driven by a synchronous motor. The capacity at present for 500 volts is as follows: One 525-kw, 500-volt motor-generator and two 100-kw, 500-volt motor-generators. The present installation of double-current machines for the 220 volts is one 600 and two 300-kw machines; there is also one 1,000-kw single-current generator, furnishing current at 220 volts, and connected across the outside of the three-wire system.

Supplementing this direct-current supply is one storage battery having a capacity on the three-hour rate of 3,500 amp.-hours. There is also being installed a new battery, the ultimate capacity of which will be about 800 amp.-hours at the three-hour rate. It is for the present being equipped for only about 4,000 amp.-hours at the three-hour rate, but the tanks have been made sufficiently large to allow plates to be added as the growth of the load requires.

The transformer equipment of this station will be of the air-blast type, of sufficient capacity to drive all the apparatus above mentioned, and in addition to furnish power for two 250-kw, 2,300-volt distributing circuits. All the switches, except those of the two incoming lines, will be of the oil-break type operated by compressed air. On incoming lines will be placed oil-break switches, operated by motors. The switchboard for the low-potential work, as well as for the high-potential, is being designed and constructed by the company's engineers, using standard hand-operated switches adapted for electric and compressed-air control. The station is laid out for the ultimate capacity of 20,000 kw of alternating and direct-current apparatus.

UNITED ELECTRIC SYSTEM.

There are two 30,000-volt lines running from the large steam sub-station No. 3 above described, to connect with the system known as the United Electric, Gas & Power system, which was taken over by the Edison Company at the beginning of last year. The system extends about 40 miles along the beach and supplies several towns, including Santa Monica, Ocean Park, Redondo, San Pedro, Long Beach, Moneta, Inglewood and Gardena with light and power. This system is operated at 17,000 volts, and there will be constructed a step-down sub-station, tying it to the 30,000-volt line. The generating capacity installed on this system is steam-driven apparatus to the extent of 800 kw. The distribution in the towns is at 2,200 volts, the lines operating at 17,000 volts Y-connected, using 10,000-volt standard transformers, thus making it available for connecting motors to the line at any point in the country for irrigation purposes. The United Electric, Gas & Power system also includes the electrical service in Santa Barbara, over 100 miles from Los Angeles, but it is not connected in on the general network of lines. A separate steam power plant there supplies current for light, power and the electric railway.

KERN RIVER TRANSMISSION.

The transmission line from Kern River Plant No. 1 to Los Angeles will be 116 miles long, and an extension of about 13 miles up the canyon will take in Plant No. 2, when it shall have been completed. The other plants will be tapped in by a separate branch at a point about 15 miles south of No. 1 plant.

The installation of generators at Kern River No. 1 will probably consist of four 4,000-kw, three-phase machines with overload capacity of 50 per cent. The machine e.m.f. will be stepped up to 60,000 volts through a delta-to-Y connection, the center of the star winding being grounded. A steel tower construction has been decided upon for the transmission line, and two three-phase circuits will be supported on one set of poles. The towers will probably be 75 ft. high and will be set about 700 ft. apart. Experiments are now being carried on with insulators for the line, and it is quite probable that some new and distinctly unique features will be introduced in the method of supporting and insulating the lines. A No. 0000 19-strand hard-drawn copper wire will undoubtedly be used for the circuits, and the line will be erected so as to stand a strain of 3,000 pounds in the center of the span. A 100-ft. right of way has been secured for the transmission line. It is quite probable that a branch from this line will be carried from the nearest point to Santa Barbara to help out the system there.

GENERAL OPERATING CONDITIONS.

Some of the features entering into the regulation, paralleling of plants and other conditions of operation of the Edison Company's system are of decided interest, especially so in view of the complexity of the high-tension distributing lines and of the fact that the operation has been eminently successful from the very beginning.

The system of the Edison Company was laid out with the idea of using the synchronous motor as an eliminator of the wattless current and as a controller of line conditions, and it has proved to be a success as such. The power factor at the peak loads is about 95 per cent. on the general system. Regulation is excellent, although the regulation of machines is in no case better than 8 per cent. at unity power factor and full load. Control of voltage on individual lighting circuits is obtained entirely by motor-driven potential regulators of the three-phase type.

The entire system, on any voltage above 10,000 is operated on the delta-to-Y, Y-to-delta plan of connection of transformers, and this has proved highly satisfactory in that the company has not, to date, lost a single transformer for which there was not a good and sufficient reason, and which could be laid to the personal equation of the operator. Only two transformers on the 30,000-volt line have been lost. The loss of one of these was due to an overload, caused by a terminal becoming unsoldered. The transformer carried 150 per cent. overload for four days, but did not give out enough smoke to make it possible to detect the trouble. The other loss was caused by the accumulation of dust in the top of an air-blast transformer, which should have been cleaned out, an arc setting the top of the transformer on fire. This seems to speak well for this system of connection with the center of the Y grounded.

Referring to the parallel operation of the plants, it might be interesting to those who see great difficulty in such operation to know that eleven different designs of machines are used as generators on this system. These machines have a rather wide range of wave form, and yet hunting has been unknown, except in the case of some synchronous motors, which trouble was easily remedied by a slight change in the form of the bridge. A short-circuit does not throw the system out of synchronism, unless it occurs between the stations involved, and then frequently the machines will come back into step if the short is relieved.

It is as much as a man's job is worth to pull a switch in the Edison stations. It has been the practice to break the fields of generators instead of pulling the switches, for the electrical engineer in charge, Mr. O. H. Ensign, believes that the pulling of switches on transformers under conditions of short-circuit accounts for the burn-outs experienced on other systems of which he has been a close observer, due to the high-potential effects.

In breaking the fields of the generators of all plants except those in the master plant, which for the time is the one having the largest amount of power, there is produced a large lagging current reducing the voltage and breaking the arc formed by the short-circuit (if such is the nature of the short, and nine times out of ten it is). As soon as the arc is broken the machines will give evidence of the fact. The fields may then be again excited and the machines will pull themselves into step so that the interruption will have lasted only 10 to 15 seconds, according to the nature of the fault or cause of the short-circuit. This method of getting rid of a short is followed continually with seven plants in parallel, and an interruption of more than 15 seconds' duration is the exception.

The telephone service is supplied by a circuit running within five feet of the cross arms all over the system, and gives great satisfaction, the line being perfectly quiet unless there is a positive fault in it.

SYSTEM OF DISTRIBUTION.

Mention has already been made in a general way of some of the different classes of service supplied from the lines of the Edison Electric Company. However, the following summary, which shows eight varieties of service, is of interest:

First, 110-volt incandescent and parallel arc lights, and also 110 and 220-volt small horse-power motors on a continuous-current Edison three-wire underground system in the business district of Los Angeles.

Second, 500-volt continuous-current motors on a two-wire underground system in the same district, for elevators, mills, etc.

Third, continuous-current series arcs in the same district.

Fourth, 110-volt incandescent and parallel arc lamps on the two-wire and on the 220-volt, three-wire secondaries of 2,000-volt, three-phase, three-wire alternating-current, 50-cycle system in the residence districts of Los Angeles and all parts of the 18 towns served by the company.

Fifth, 220-volt lamps on an all-secondary, 440-volt, three-wire system balanced between the three phases of a 10,000-volt primary transmission, at a sub-station in Whittier.

Sixth, alternating-current series arcs in Santa Barbara, Santa Monica, Long Beach, Passadena, Santa Ana and Pomona.

Seventh, series incandescent lamps of 50 and 100 volts on 2,000-volt circuits in several of the inland towns, particularly in Pasadena, Santa Ana, Pomona and Redlands.

Eighth, 110, 220, 440, 550 and 2,080-volt, three-phase synchronous and induction motors in the various cities and towns, and the surrounding territory in the San Gabriel, San Bernardino, Riverside, La Habra, Redondo, Santa Ana Valleys from 17,300, 10,000 and 2,200-volt primaries, for deep well, centrifugal, rotary, triplex, propeller and air-lift compression pumping plants, elevators, planing mills, cement works, rock crushers; 10,000-volt motor-generator sets for electric railways, automobile charging stations, printing offices, brickyards, refrigerating plants, etc., in nearly every use in fact, and in installations from ½ to 200 hp.

The magnitude of the electric pumping, which is the largest motor service supplied, is difficult of conception to any one who has not lived in a land where rains are unknown during the six or eight months between May and November, and where the warm, dry summer sunshine will do anything required of it when accompanied by artificial irrigation. This service amounts to 2,896 hp in 93 motors, while there is a total of 424 motors aggregating 5,560 hp installed on all the distributing systems of the company.

Not only is a great diversity of service supplied, but there are probably few systems in the world which have so great a variety of apparatus, either in their distribution circuits or in the various generating plants and sub-stations, as is found on the Edison system. This is due to the consolidation of separate companies distributing throughout a wide area in Southern California; to the extreme rapidity of growth in this section of California, and finally to the great distance from the source of supply of apparatus and the consequent delay in getting the kind of material needed. There are General Electric, Westinghouse, Stanley, Pittsburg and Wagner lighting transformers; three types of General Electric-Thomson high-torque induction meters, Thomson commutator meters on alternating-current and direct-current circuits; Thomson polyphase, Sheefer, Stanley, Westinghouse (new), old Shallenberger ampere, Duncan ampere, Duncan watt, and Westinghouse "cyclometer" meters still "doing business at the old stand" on the distributing systems, although nearly all station apparatus, as well as motors, meters, arc lamps and transformers are of the General Electric Company's make.

The following data give a comprehensive idea of the magnitude

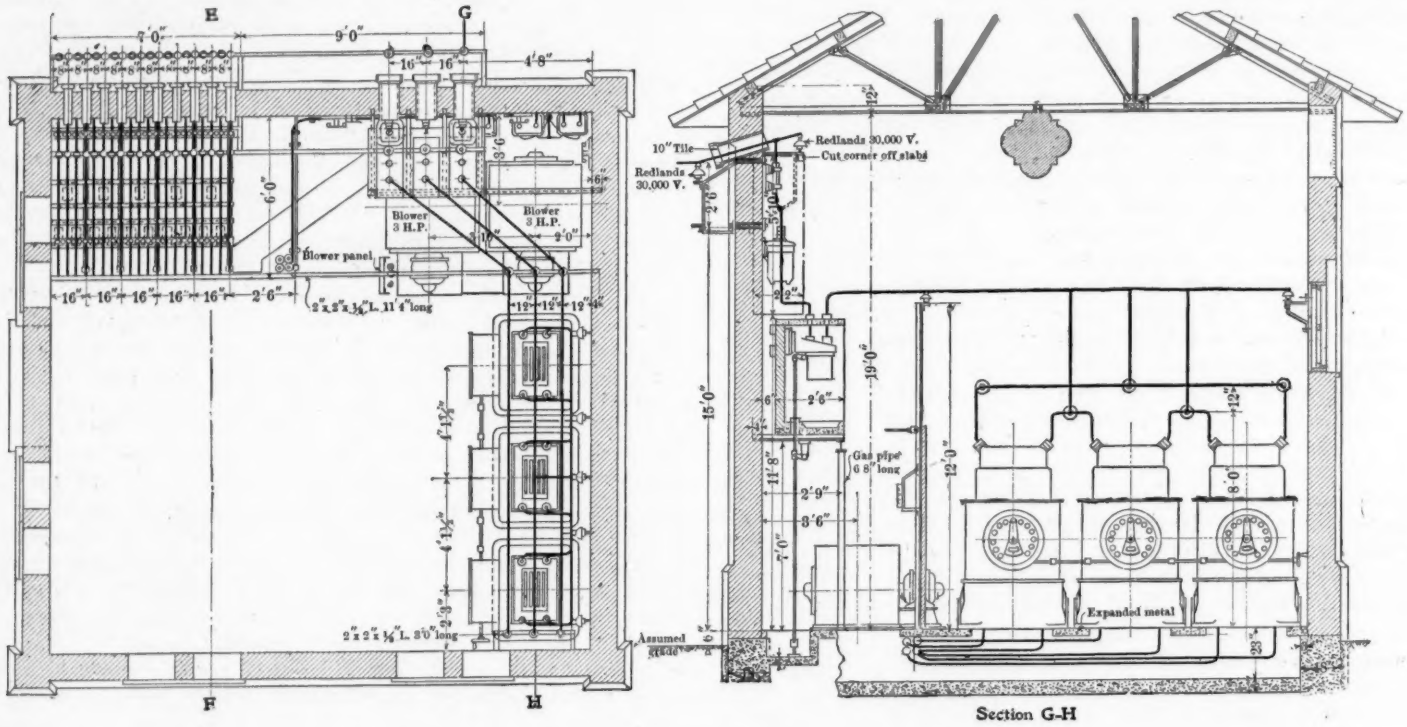


FIG. 29.—PLAN AND SECTION LOS ANGELES SUB-STATION.

Total perimeter series arc circuits (7 towns)	52 miles
Total perimeter 2000-volt service incandescent circuit (8 towns)	173.2 miles
Total perimeter 2000-volt, 3-phase light and power circuits (16 towns)	131.8 miles
Total perimeter 2000-volt, 1-phase lighting circuits (15 towns)	215.3 miles
Total poles for above	13580
Total length of pole line (2000-volt)	342.7 miles
Total length of 10,000-volt sub. and transmission line	94.7 miles
Total length of 17,000-volt sub. and transmission line	48.4 miles
Total length of 30,000-volt line	106.0 miles
Total poles for 30,000-volt line	4192
Total length of 10,000 and 17,000-volt line	143.1 miles
Total poles for same	5540
Total length of separate telephone and signal line Mill Creek and Lytle Creek	9.0 miles
Total poles for same	340
Total poles of all kinds	23652
Total length of pole lines of all kinds	600.8 miles
Total Los Angeles underground Edison 3-wire 220-volt tubing	9.3 miles
Total Los Angeles underground lead Edison feeders for same	15.3 miles
Total Los Angeles underground Edison 2-wire, 500-volt tubing	8.5 miles
Total Los Angeles underground lead-encased feeders for same	1.1 miles

CITY SUB-STATIONS.

Extensive reorganization of all the distributing systems is going on, especially in Los Angeles, where it has been impossible to keep pace with the rapidity of growth. There are now being installed in that city three 15,000-volt sub-stations, from each of which will radiate a three-phase distribution, probably composed of four-wire, 3,500-volt circuits. Between station No. 2 and these sub-stations there are being built transmission lines of 55 to 70-ft. poles, spaced 120 ft. apart, and strung with No. 5 seven-strand bare copper wire which will be placed high above all other lines.

Fig. 29 shows plan and section of the sub-stations designed for this service. Each building will be 20 ft. square on the inside and 19 ft. clear above the floor to the trusses. The walls will be of concrete 12 in. thick and will support a steel-truss roof covered with tile, the general design being a very harmonious and pleasing one. The 15,000-volt wires will enter through three 10-in. tiles and be connected to single-pole, single-throw switches, lightning arresters, current transformers, and overload relays, from which the circuits pass to the main transformers. From there the secondary wires

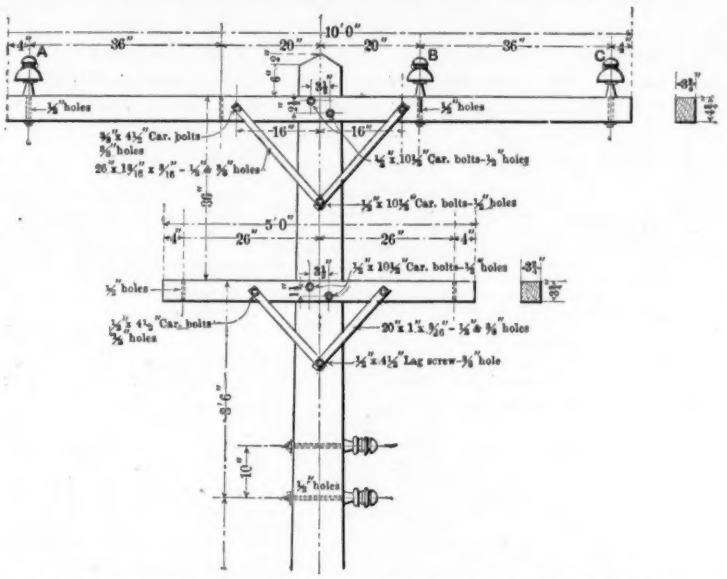


FIG. 30.—NEW STANDARD 10,000-, 7,300- AND 30,000-VOLT POLE CONSTRUCTION.

pass under the floor to the six-panel distributing switchboard and thence out through 4-in. tile pipes.

LINE CONSTRUCTION.

The company's engineers have put much careful study on line construction, and while there are still many different types in service, the company is gradually working to the standards illustrated in the accompanying figures. Fig. 30 shows the new standard high-tension pole construction for 10,000, 17,300 and 30,000-volt circuits. The top cross arm is 10 ft. by 3¾ in. by 4¾ in. and has four insulators with 36-in. spacing. The lower cross arm is placed 36 in. below and is 5 ft. by 3¾ in. by 3¾ in. It has a pin 4 in. from each end. The three pins on each side of the pole do not

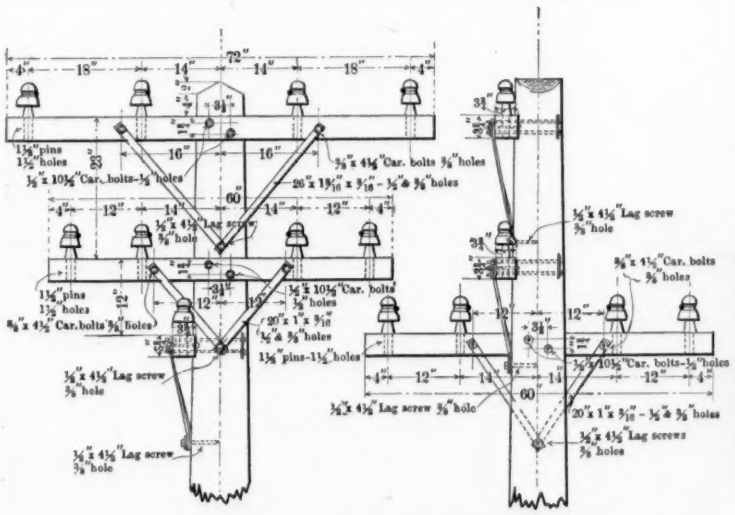


FIG. 31.—THREE-PHASE, 2,000-VOLT LINE CONSTRUCTION.

form an exact equilateral triangle. Both arms are bolted to the pole and are supported by iron braces. All insulators are secured by bolts through the cross arms. The telephone insulator pins are fastened 2 ft. 8 in. and 3 ft. 6 in. below the lower cross arm by bolts which pass through the pole.

For the three-phase, 2,000-volt lines the construction shown in Fig. 31 is used. The top primary arm is 72 in. long and has four pins 18 in. apart. The lower secondary arm is 60 in. long with four pins. A 60-in. buck arm for house service is also shown. The six-pin trunk line construction is similar.

In 2,000-volt work as well as in higher voltages the aim is to put lines up in such shape that it is not necessary to constantly "pull up slack." Some of the special features of the line construction are as follows: Double cross arms on all corners and wherever any two wires of any size are dead-ended; iron centered on all double cross arms; poles, pins and cross arms painted with two coats of the best green paint; galvanized iron under guy wires and cables; specially designed goose-egg porcelain strain insulators for guys; specially designed house brackets; wide distances between wires and especially between "inside" wires; tall stocky poles; specially designed guy anchors; cross arm buck arms for service taps, etc.

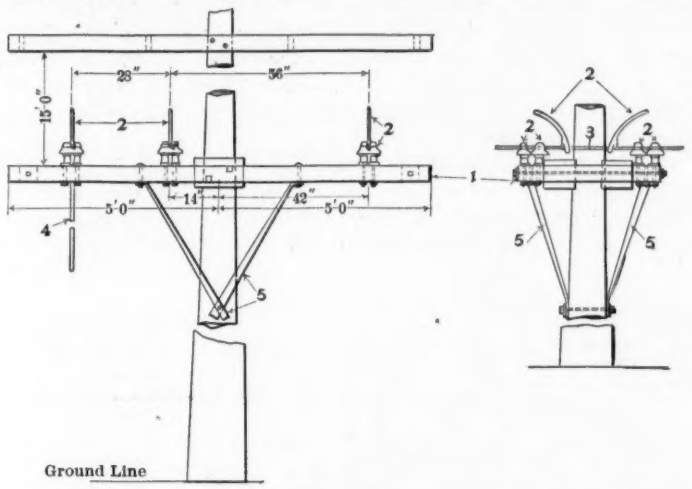


FIG. 32.—10,000 AND 15,000-VOLT OUTSIDE FUSIBLE SWITCH.

In the words of the company's superintendent of distribution, "its lines do not 'bag at the knees' and cause constant 'fixing.'" Fig. 32 illustrates outside 10,000 and 15,000-volt fusible switches of the

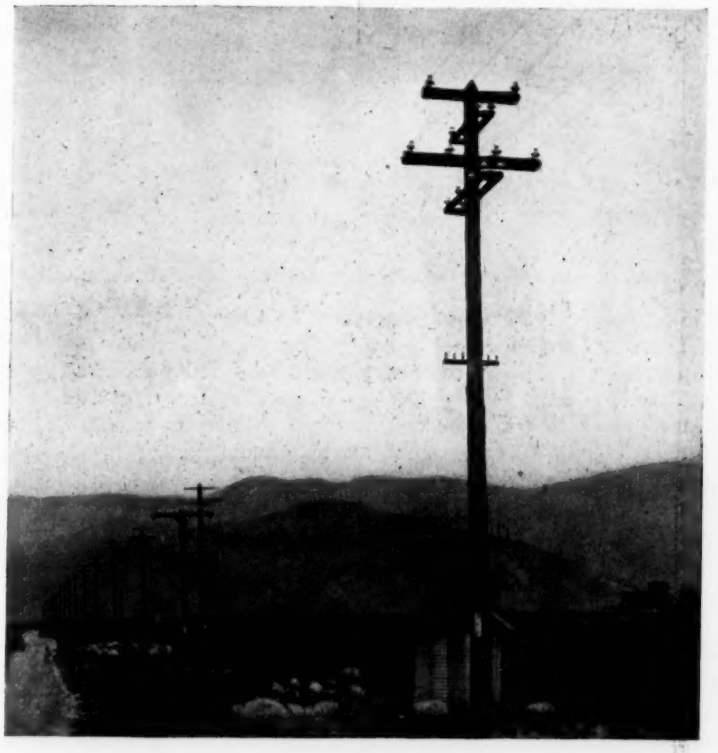


FIG. 33.—33,000-VOLT TRANSMISSION, SHOWING PLATFORM FOR OPERATING HORN SWITCHES.

ram's horn type. The operating platform from which the horn switches are opened and closed is shown in Fig. 33.

LONG SPAN CONSTRUCTION.

The Edison Electric Company is experimenting on some rather original work in long span construction. It now has erected two sections of line of two miles in length each, in different parts of its system where occur the strongest windstorms, which blow now and then during the summer. The construction used is illustrated

in Fig. 34. Each of these lines has at present one circuit, composed of No. 5 stranded cable. One of the sections contains seven strands of copper conductor, and the other contains three strands copper conductor. The spans are 225 ft. in length, and 18 in. sag is allowed. A telephone line composed of a copper cable of three strands of No. 17 wire twisted together is also installed on this line and is transposed every other pole. The severest windstorm which has occurred in this part of the country in many years swept across these lines last summer without injuring them or raking the poles in any way.

There is now being constructed nine and one-half miles or more of medium-span line to Lytle Creek, near San Bernardino, directly in the path of the severe north winds, of the 40-ft., round cedar pole, 225-ft. span construction, with deep-groove, double-petticoat insulators on 10,000 volts. Half of it is to be strung with No. 5 and half with No. 6 cables, and it is expected that a saving of 24¼ per cent. and 26½ per cent. will be effected over the ordinary construction. This is a single-circuit line prepared for drawing in another one eventually.

The company is now building 14 miles of line from Los Angeles to Englewood to connect the old United Electric, Gas & Power Company's beach town, 38-mile, 17,300-volt transmission system, which the Edison Company has, as was stated, lately acquired, with

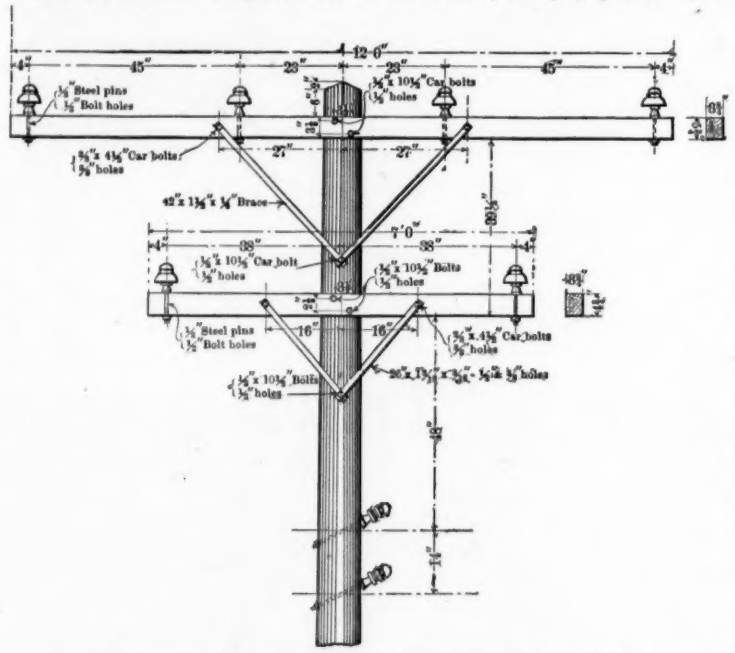


FIG. 34.—10,000 AND 15,000-VOLT, LONG SPAN CONSTRUCTION.

the 30,000-volt Edison system proper. This line is composed of six No. 4 seven-strand copper wires, strung on new special porcelain insulators and a three-strand telephone cable. Thirty thousand volts will be impressed on the line. The 40-ft. poles are of steel and placed 300 ft. apart. The cross arms are of wood because of the danger of birds burning wires off by grounding, but special iron pins have been designed and all pins are to be grounded together by a fine wire underneath the cross arm to prevent burning of the wooden parts. The soil is mostly sand in this region, and there is used a cylinder of cement 5 ft. deep in which to set the poles. Even then the cost is only $48 per mile more than a wood pole line with 125-ft. spans, because wood poles must be taller than 40 ft. The cost of a 40-ft. tripartite pole made by the Franklin Rolling Mill, of Franklin, Pa., in this steel construction, is about $35 f.o.b. Los Angeles, as against $9 for a 45-ft. cedar pole. The advantage in the case of iron pole lines is the fact that should the line ever be changed or moved the iron poles would be as good as new for a new location. Wooden poles, on the other hand, even though they be not rotted badly, are not worth placing again unless sawed off.

This construction of these long-span lines would not be permissible in sections of the country subject to snow and ice, since the stranded copper would collect more sleet and would probably be unsafe. Should the lines just described be found satisfactory after several years they will probably be adopted as a standard construction for cross country runs.

TESTING DEPARTMENT.

The Edison Company is justly proud of its testing department, which contains apparatus for the complete testing of all kinds of installations from a 1/10-hp sewing machine motor to a central station or hydraulic power house. It has a 5-kw Wagner 80,000-volt transformer and a 100-kw, 150,000-volt Stanley testing set of ten transformers of 15,000 volts each; besides wattmeters, ammeters and voltmeters, with multipliers, current and potential transformers, some 25 in number, of various capacities; also many motors, transformers, generators, etc., for obtaining any ordinary voltage, amperage and cyclage. The department is in the same building as the general store, which adjoins the Southern Pacific freight depot, and occupies a 50 by 50-ft. space on each of two floors.

RATES.

For its lighting and power services the company has in use a sliding scale of rates, the price varying according to the amount of power used. A minimum price of $1 for "readiness to serve" is paid by all light subscribers and $2 a month for all power users. The light rates are as follows:

For 6⅔ kw-hours or more, and less than 13⅓ kw-hours	$.15 per kw-hr.
For 13⅓ kw-hours or more, and less than 26⅔ kw-hours	.14 per kw-hr.
For 26⅔ kw-hours or more, and less than 66⅔ kw-hours	.13 per kw-hr.
For 66⅔ kw-hours or more, and less than 200 kw-hours.....	.12 per kw-hr.
For 200 kw-hours or more, and less than 333⅓ kw-hours....	.11 per kw-hr.
For 333⅓ kw-hours or more, and less than 666⅔ kw-hours	.10 per kw-hr.
For 666⅔ kw-hours or more, and less than 1333⅓ kw-hours..	.08 per kw-hr.
For 1333⅓ kw-hours or more, and less than 2000 kw-hours ..	.06 per kw-hr.
For 2000 kw-hours or more, and less than 6666⅔ kw-hours ...	.05 per kw-hr.
For 6666⅔ kw-hours or over	.04½ per kw-hr.

All lamp renewals of lamps of 8 cp and over are free. The schedule of rates for power users is as follows:

For 13⅓ kw-hours or more, and less than 25 kw-hours.....	$.15 per kw-hr.
For 25 kw-hours or more, and less than 125 kw-hours	.12 per kw-hr.
For 125 kw-hours or more, and less than 250 kw-hours	.09 per kw-hr.
For 250 kw-hours or more, and less than 500 kw-hours	.08 per kw-hr.
For 500 kw-hours or more, and less than 750 kw-hours	.07 per kw-hr.
For 750 kw-hours or more, and less than 1000 kw-hours	.06 per kw-hr.
For 1000 kw-hours or more, and less than 2000 kw-hours	.05 per kw-hr.
For 2000 kw-hours or more.....	.04 per kw-hr.

A card catalogue system is maintained for a record of all customers, the cards for both light and power users being 9 in. by 5¼ in. in size. On one side of the card are blank spaces for the address, name, collecting address, contract number, dates of contract, time connected and disconnected, description of the meter, lamps connected and other information for the proper recording of the contract by the bookkeeping department. On the reverse side of the card is printed the agreement with prices and other regulations, blank spaces being left for the name and address and the signature of the solicitor. Across the face of the agreement is a red ink space for the stamp of approval by the president or other officer of the company.

CONCLUSION.

The Edison Electric Company, although organized less than ten years ago, is now one of the most solid corporations in the State of California. It has a capitalization of $10,000,000 and an authorized bond issue of $10,000,000, over $8,000,000 of which is held in escrow for the acquisition of other plants, development of water power and other permanent extensions and additions. Its officers include the following named gentlemen: President and treasurer, John B. Miller; vice-presidents, Henry Fisher, J. S. Torrance and H. H. Sinclair; secretary, W. R. Staats; assistant secretary, R. H. Ballard; assistant treasurer, W. L. Percy; manager, A. L. Selig; purchasing agent, H. S. Benedict; superintendent of power development, F. E. Miller; chief hydraulic engineer, F. E. Finkle; mechanical and electrical engineer, O. H. Ensign; superintendent of distribution, C. A. Copeland; chief operator, B. F. Pearson.

Practically all the hydraulic work, especially on the newer plants, has been designed by and installed under the supervision of Mr. Finkle, although the earlier work on the Santa Ana plant No. 1 was executed under the direction of Mr. Ensign, who was assisted on the hydraulic features by M. L. Lumm and E. M. Boggs. The power development work is now being carried on under the general supervision of F. E. Miller. Mr. Ensign's work dates back to the Santa Ana plant just mentioned, as well as to the first Mill Creek plant, and he has successfully directed the electrical and mechanical development of the system for a number of years. He designed the Redlands type of insulator still used, he successfully planned and inaugurated the 3,000-volt line to Los Angeles, the longest of its kind at that time; he has designed and directed the work on the steam turbine station No. 3 and has in hand the electrical features of the Kern River work. Mr. Copeland, as superintendent of distribution, has charge of the distribution of all the power and of the designing and erection of transmission lines, distributing sub-stations and motor installations. As already mentioned, the standard-

izing of the distribution system is now being worked out under his supervision. The position of chief operator is being successfully filled by Mr. Pearson, under whose supervision falls the operation of all the generating plants and of the principal sub-stations, 18 in number, and the personal direction and management of the operating force, which numbers about 150 men.

Outside of the field of pure engineering probably the greatest credit due to any one man for the rapid and successful growth of the Edison Company's system, as well as for its undeveloped resources, falls to Mr. H. H. Sinclair. Mr. Sinclair had the early management of the Mill Creek and Santa Ana plants, and he has personally investigated and filed appropriation claims on nearly all the water rights owned by the company, including those on Kern River. President J. B. Miller, who entered the company as treasurer some seven years ago, has been largely instrumental in placing the company on its present solid financial footing, and he now exercises a personal and progressive supervision over all the departments.

Several of the photographs used as illustrations in this article were taken by Mr. Pearson.

Harmonic Analyzer.

By George H. Rowe.

THOSE who have had occasion to make analyses of any considerable number of curves for the relative amplitudes and phase relations of the various component harmonics, must have felt the need of less laborious methods than most of the analytical and graphical methods proposed.[1] Mechanical analyses by means of analyzers or integraphs give quick and accurate results. Analyzers are, however, commonly expensive and usually require the replotting of the curve to be analyzed to correspond to a particular wave length for which the machine was designed.

The analyzer here described is the result of an attempt to make an accurate but inexpensive instrument of sufficient range for practical purposes, and one capable of being employed on oscillograms or other periodic curves without the necessity of enlarging or otherwise changing the original scale. Since most laboratories and shops are provided with planimeters, it was decided to adopt the planimeter form of the instrument, and to make the parts in addition to the planimeter as few and simple as possible.

Expressed in terms of Fourier's series, any single valued periodic wave becomes:

$$y = \tfrac{1}{2} A_0 + A_1 \sin \Theta + A_2 \sin 2\Theta + \ldots A_n \sin n\Theta + B_1 \cos \Theta + B_2 \cos 2\Theta + \ldots B_n \cos n\Theta$$

in which such terms as A_n and B_n are constant coefficients, y is the ordinate corresponding to any angle Θ, which varies with x, and $\tfrac{1}{2} A_0$ is a constant term equal to the mean ordinate of the wave. By assuming the axis X to divide the given wave into two halves, above and below the axis, the constant term disappears.

The values of the coefficients are well known to be:

$$A_n = \frac{1}{\pi} \int_0^{2\pi} y \sin n\Theta \, d\Theta \quad \text{and}$$

$$B_n = \frac{1}{\pi} \int_0^{2\pi} y \cos n\Theta \, d\Theta.$$

Let the length of one cycle of the wave be equal to $2l$, measured along the axis of X. Then

$$\Theta = \frac{\pi x}{l} \quad \text{and} \quad d\Theta = \frac{\pi \, dx}{l} \quad \text{and}$$

$$A_n = \frac{1}{l} \int_0^{2l} y \sin n\Theta \, dx,$$

$$B_n = \frac{1}{l} \int_0^{2l} y \cos n\Theta \, dx.$$

The automatic integration of the above expression by means of a planimeter can be clearly understood by considering the theory of [2]Yule's analyzer. In Fig. 1 D is a disc, the center of which is made to follow the curve. Its periphery is always in contact with the straight edge, $A\,B$, which moves so as to remain parallel to the axis, $o\,l\text{-}2\,l$. Also the periphery of D is contained in the length $2\,l$ exactly n times, so that p on the arm attached to D will turn through an angle $\frac{n\pi x}{l}$, while the center of the disc passes through a horizontal distance, x. Suppose the distance $p\,O$ is equal to r, and that when o

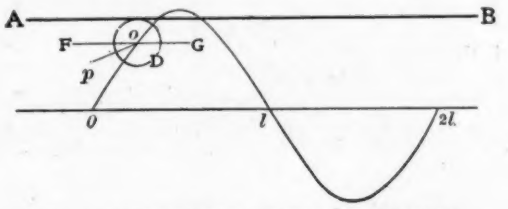


FIG. 1.—INTEGRATION BY YULE'S ANALYZER.

is at the initial position, p is on the line $o\,l$ and to the left. Then if x and y are the co-ordinates of the center of the disc, O, the co-ordinates of p will be:

$$x - r \cos n\pi \cos n\Theta$$

and

$$y + r \cos n\pi \sin n\Theta$$

and the area traced out by p will be

$$K_n = \int y \, dx - r \cos n\pi \int y \, d(\cos n\Theta) + r \cos n\pi \int \sin n\Theta \, dx - r^2 \int \sin n\Theta \, d(\cos n\Theta).$$

If the integration is carried through the closed cycle back along the line $2\,l\text{-}o$, the last two integrals reduce to zero, and the area as measured by a planimeter, the tracing point of which follows p, will be:

$$K_n = \int y \, dx + \cos n\pi \frac{r\,n\pi}{l} \int_0^{2l} y \sin n\Theta \, dx.$$

And if, as usual, the line $o\,l\text{-}2\,l$ divides the wave above and below

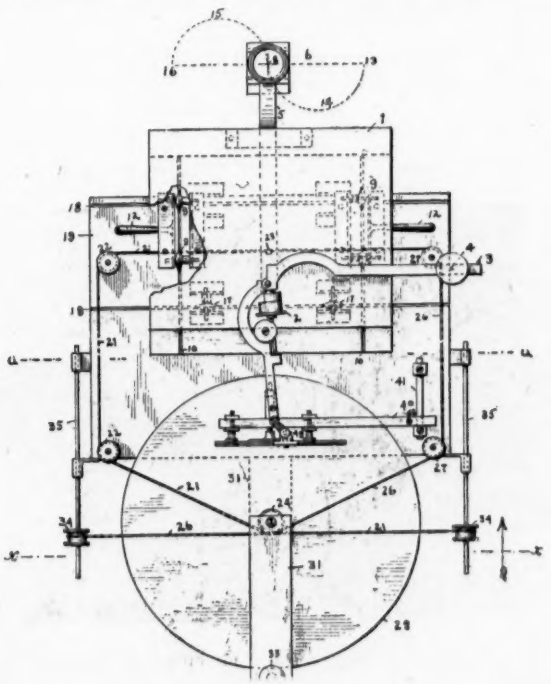


FIG. 2.—PLAN VIEW OF ROWE ANALYZER.

the axis into equal areas, the area of the curve $\int y \, dx$ cancels from the instrument reading and we have:

$$K_n = \frac{r\,n\pi}{l} \cos n\pi \int_0^{2l} y \sin n\Theta \, dx, \quad \text{or}$$

$$K_n = r\,n\pi \cos n\pi \, A_n \quad \text{or}$$

[1] Henrici, *Phil. Mag.*, Vol. XXVIII, p. 110; Yule, *Phil. Mag.*, Vol. XXXIX, p. 367; Michelson and Stratton, *Phil. Mag.*, Vol. XLV, p. 85; Le Conte, *Phys. Review*, Vol. VII, p. 27.

[2] *Phil. Mag.*, Vol. XXXIX, p. 367.

$$A_n = \frac{K_n = \textit{planimeter reading}}{\cos n\pi \cdot r \cdot n \cdot \pi}.$$

B_n will be obtained by starting the point p from the position at right angles to and below the line $o\ l\text{-}2\ l$. Its value will be:

$$B_n = \frac{K_n' = \textit{planimeter reading}}{r \cdot n \cdot \pi \cdot \cos n\pi}.$$

If the tracing point of the planimeter is constrained to move backward and forward with simple harmonic motion along the line $F\,G$,

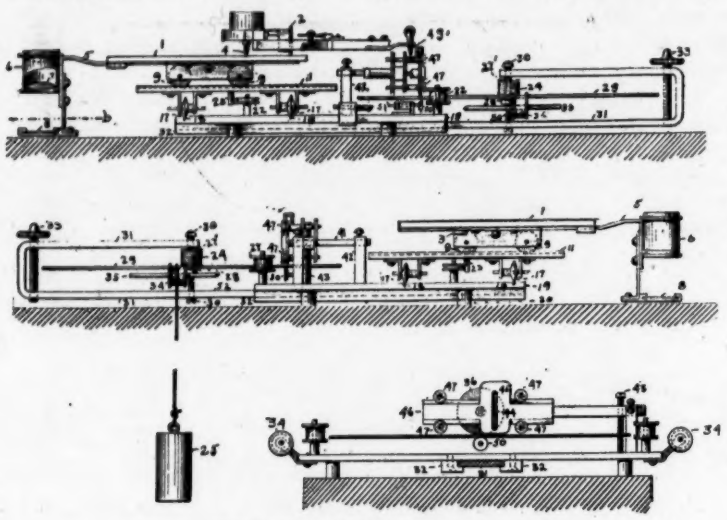


FIG. 3.—ELEVATION VIEWS OF ROWE ANALYZER.

while the point p revolves, and if r is now the half amplitude, then the co-ordinates of the tracing point will be:

$$x = r \cos n\pi \cos n\,\Theta \text{ and } y;$$

and the area of the tracing point around the closed area, will be:

$$K_n = \int y\,dx + \cos n\pi \frac{n\pi r}{l} \int_0^{2l} y \sin n\Theta\,dx,$$

which gives, when the base line is properly selected:

$$A_n = \frac{K_n = \textit{planimeter area}}{r \cdot \pi \cdot n \cdot \cos n\pi}$$

as before.

[1] Le Conte, in his analyzer, mounts the planimeter wheel and pole

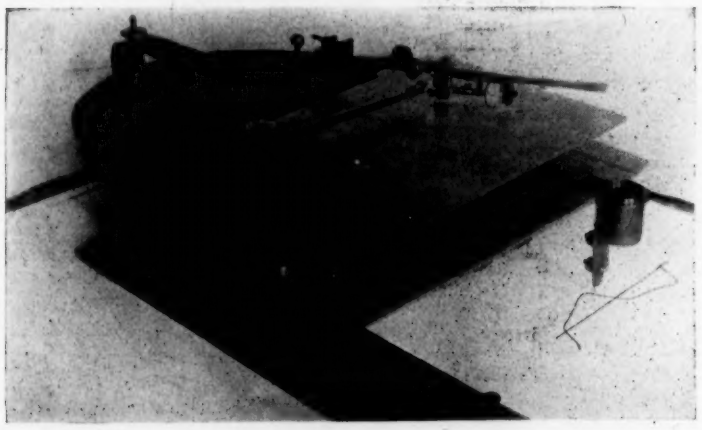


FIG. 4.—PERSPECTIVE VIEW OF ROWE ANALYZER.

on a platform, every point of which is made to generate the curve to be analyzed, and the tracing is given harmonic motions of different frequencies by means of a system of gears.

An instrument devised by the writer as a further modification of the preceding instrument is shown diagrammatically in Figs. 2 and 3 and in perspective in Fig. 4.

Referring to the diagram, the instrument is seen to consist of two platforms, I and II, moving at right angles to each other. On the upper platform is placed the planimeter wheel, 2, and pole 4, the tracing point, 49, being given a backward and forward movement by means of the pin and slot arrangement shown in Fig. 3. Every point of the upper table is made to generate the curve 13-14-8-15-16 by means of the handles, 12, and the cross hairs, 8. Motion is transmitted from table II by means of a flexible string, 21, attached to the stud, 23, on the lower platform, and passing around pulleys 22, making one complete turn around pulley 24 and thence to the weight, 25. A similar string, 26, symmetrically arranged, passes from stud 23 around pulleys 27, making a complete turn about grooved pulley 24 and then to a similar weight, 25. Or, a better arrangement is to dispense with the weights by connecting the ends of the strings by means of a spiral spring. The inertia is thus much reduced. For a similar reason the tables are made of aluminum. The pulley, 24, is of hard rubber on which screw threads are cut to prevent slippage of the cords 21 and 26. This pulley screws on the shaft 27′ and may be quickly changed in order to change the range of the instrument. From disc 29 motion is communicated by friction to the wheel 36, which has a pin, 44, working snugly in the slot shown, causing the piece, 46, to move backward and forward with simple harmonic motion between the grooved wheels, 47, which serve to keep it in place and free from side motion.

The number of complete oscillations of the point 49, while the cross hairs move from 13 to 16, is determined by the diameter of the pulley 24, the diameter of the wheel 36, and the distance of the point of contact of the wheel 36 from the center of the disc 29. The proper distance, r, of the point of contact is in general:

$$r = \frac{n\pi\,d\,d'}{2\,l} = \frac{\textit{constant}}{\textit{wave length}},$$

d and d' being radii of the wheel 36 and the pulley 24 respectively, and l the wave length.

The method of operation is as follows:

Place the curve to be analyzed so that it is symmetrical with respect to the straight line, 13-8-16. If only one loop of a curve is given, 13-14-8, invert it and place below the line, making loops symmetrical. To determine A_1 set scale for the position of the friction wheel, 36, for one complete oscillation of the point, 49, as already explained. Set also the point 49 to the extreme right of its travel in Fig. 2, when the cross line, 8, is at 13, and read the planimeter. By means of the handles, 12, and sighting through the lens, 7, the cross lines, 8, are made to follow the curve, 13-14-8-15-16, when the screw, 43, is made to lift the friction wheel, 36, from the disc, 29. The cross line, 8, is now brought back to the original position along the line 16-8-13, and the planimeter reading is again taken. This reading may be either positive or negative. The area so found equals the coefficient, A_1, multiplied by $\cos\pi$ times r times π, where r is the distance of

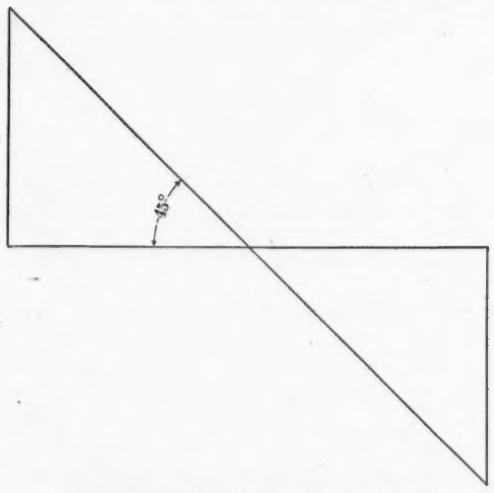


FIG. 5.—STRAIGHT LINE FOR ANALYSIS.

the pin, 44, from the center of the friction wheel, 36. Hence, the coefficient, A_1, is equal to the difference of the planimeter readings (to which is given the proper sign), divided by $\cos\pi$ times r times π. For the nth coefficient, set the wheel, 36, at such a distance from the center of the wheel, 29, that the point, 49, makes n complete oscillations, and the nth coefficient, A_n, will equal the difference of the planimeter readings divided by $\cos n\pi$ times $r \times n\pi$. Simi-

[1] J. N. Le Conte, *Phys. Review*, Vol. VII, p. 27.

larly, B_n is obtained, the only difference in the process being that the point, 49, is now started at the maximum downward position of its travel when the cross lines are at 13. B_n is, therefore, the difference between the planimeter readings divided by $\cos n\pi$ times r times $n\pi$.

The coefficients of Fig. 5 can be calculated from the equation:

$$A_n = -\frac{1\,(-1)^n\,2\pi}{\pi n},$$

and $B_n = 0$.

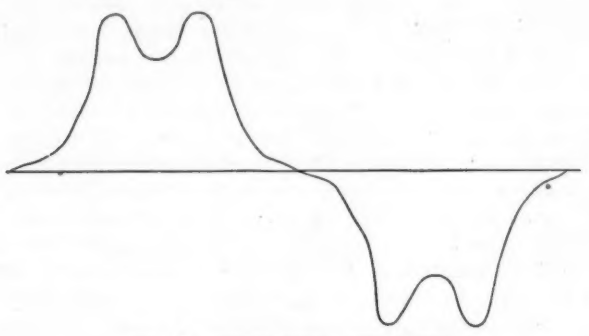


FIG. 6.—CURVE FROM STEINMETZ.

Applying the instrument, the following results were obtained, the wave length being 3½ in.:

Harmonic.	Calc. value.	Inst. value.					Max. error.	% of A_n	% of A_1
1	+1.109	1.102	1.102	1.102	1.113	1.102	.007	.6	.6
2	—.5545	.55	.557	.56	.547	.556	.0075	1.35	.625
3	+.369	.371	.372	.362	.368	.362	.007	1.95	.65
4	—.277	.28	....	....	....	....	.003	1.08	.27
5	+.2201	.2175	....	....	....	....	.0026	1.18	.23
6	—.185	.186	....	....	....	....	.001	.55	.09
7	+.1584	.1595	....	....	....	....	.001	.63	.09
8	—.1386	.139	....	....	....	....	.0004	.29	.036
9	+.123	.126	....	....	....	....	.003	2.44	.271
10	—.1109	.112	....	....	....	....	.0011	.925	.0925

The analysis of Fig. 6 as given by Steinmetz is:

$$e = E\{(\sin\theta - .12\sin(3\theta - 2.3°) - .23\sin(5\theta - 1.5°) + .134\sin(7\theta - 6.2°) - .002\sin(9\theta + 27.7) - .046\sin(11\theta - 5.5°) + .031\sin(13\theta - 61.5°)\}$$

By the analyzer it is:

$$e = E\{(\sin\theta - .128\sin(3\theta - 51') - .208\sin(5\theta - 25') + .14\sin(7\theta + 4°\,10') - .013\sin(9\theta - 27°\,50') - .043\sin(11\theta - 11°\,43') + .043\sin(13\theta + 51°)\}$$

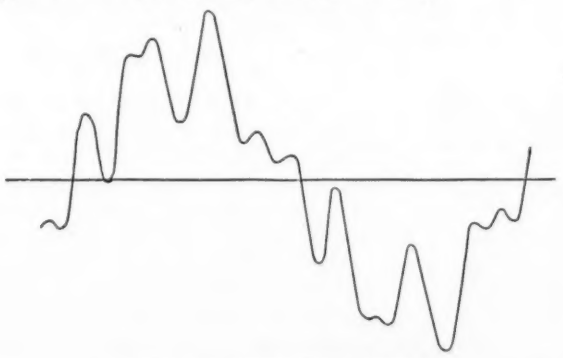


FIG. 7.—CURVE FROM FIELD.

Fig. 7 was taken with a Duddell oscillograph by [4] Field from a three-phase generator feeding cables. Its equation is:

$$e = E\{\sin(\theta + 4°\,55') + 0\sin 3\theta - .141\sin(5\theta - 6°\,40') + .313\sin(7\theta - 12°\,50') + 0\sin 9\theta + .174\sin(11\theta + 63°\,25') - .077\sin(13\theta - 83°\,5') + 0\sin 15\theta.$$

The wave lengths of the preceding curves were 3½ and 5 4/10 in. respectively, and the constants of the instrument were such that the number of terms possible was 10 and 15 respectively.

The operation of the instrument is simple, the error is less than 1 per cent. of the first harmonic or fundamental, and the time necessary, is simply that required to trace the curve twice for each harmonic. The complete analysis of the curve given in Fig. 7 for the odd terms up to the 15th consumed about two hours. The instrument was made by Mr. W. J. Waggener, 420 Montgomery Street, San Francisco.

[4] London Inst. Elec. Eng., Feb. 10, 1903.

Some Suggestions as to Newspaper Advertising for Central Stations.

By W. H. WINSLOW.

IN preparing copy for newspaper advertisements the general station man must bear in mind that his efforts will not be searched for, except by himself. Neither can he, as a rule, use sufficient space so that his ads will demand attention merely on account of their size. His problem, therefore, is to devise a means of insuring that his announcements will be read without resorting to anything bizarre or in bad taste.

The plan here suggested has proved very successful, and anyone who adopts it will find that his advertisements will be the most prominent things on the pages which they adorn.

It consists essentially of the purchase of a few fonts of a large legible type to be used for your own announcements exclusively and differing from anything in regular use by the paper in which they appear. The type in which the advertisement here reproduced (but reduced to about 16 points) is set, is known as 28-point Caslon Old Style and has the reputation of being the most legible face ever cut. It can be used to advantage in two ways—first, as in the example given, in a few lines well spaced and surrounded by plenty of white space, and second, in two or three lines well spaced, as before, and followed by matter in small type. While Caslon Old Style is probably the best type for this purpose, there are other plain, bold and legible faces which can be used if the Caslon is preempted, though, as a matter of course, the results will not be so good if others are already using the same idea. When there is no

A salesman can talk to only one customer at a time, an Electric Sign talks to thousands and keeps your name and business constantly before the public. If you have all the business you want don't get an electric sign.

EXAMPLE OF ADVERTISEMENT.

competition in the lighting business, it is just as well in this style of announcement to omit all reference to name and address. It is "different" and that in itself is good advertising. The following are offered as suggestions for "copy." Some of them are original, others have been culled from various sources.

"Is your place of business lighted so well that no one can pass it after dark without looking in? The store that people can pass without noticing it isn't getting its full share of business."

"Money paid for lighting your store is an investment, not an expense. There are people here paying big rents for places on the main streets and throwing away half their value by not lighting them up brilliantly. A dim store might almost as well be in a back street."

"When your show windows are dark after you close up, they might as well not be there. Keeping them lighted, not half lighted, mind you, is the cheapest advertising known. Lights can be extinguished by clockwork at any hour."

"Is yours one of the houses that looks like a vacant one after nightfall? Do you think that it pays to stumble around in the dark? Some of the homes here are enough to give their inhabitants melancholia. A bright home is apt to be a happy one.

"Burn your name into the public mind with an electric sign; back it up with brilliantly-lighted windows and store and see your business grow."

"Nothing succeeds like light. Shrewd merchants welcome a dark day when they can light up while the other fellows' places look like holes in the wall."

"You advertise to place and keep your name and business before the buying public. Do you realize the advantages of electric advertising?"

"The man who has the shrewdness to light up his place so brilliantly that it fairly reaches out and grabs the passerby gets back dollars for dimes."

"Young people like plenty of light. Make your house bright and attractive and you will find it easier to keep the boys at home in the evening. We know of one man who keeps his house brightly

lighted for this reason. He says it is the cheapest way he knows of to keep his boys away from bad company."

Different local conditions demand varying arguments, but the above illustrate the idea—that of using a few terse sentences which can and will be read at a glance. I generally prepare six or seven announcements, which are alternated daily for one or perhaps two weeks, after which a new series is used.

In papers of ordinary get up as to their advertisements, it is surprising how impossible it is to look at a page containing one such as I have described without seeing it first, almost to the exclusion of everything else. Two fonts of type costing about $8 will set any of the advertisements which I have given above.

Some Tests of Tantalum Lamps.

BY A. E. KENNELLY AND S. E. WHITING.

SINCE tantalum incandescent lamps have so recently been developed commercially, some tests made by the writers upon a few samples of these lamps may be of interest.

A batch of ten tantalum lamps was received through the courtesy of Mr. Edward D. Adams, who obtained them from Messrs. Siemens & Halske, of Berlin. These lamps were all alike, and of the type shown in recent issues of the ELECTRICAL WORLD AND ENGINEER (pp. 200 and 379 of the current volume). All of them had frosted globes and were marked uniformly 110-25, which was interpreted to mean 110 volts and 25 normal horizontal hefners (22 normal horizontal British candle-power).

Figs. 1 and 2 indicate the behavior of one of these lamps (No. 2) in respect to resistance, current, power, luminous intensity (horizontal candle-power), luminous efficiency and specific consumption (watts per candle). The corresponding data are indicated also, in dotted lines, for a particular Edison carbon filament lamp nominally of 120 volts, 16 cp, and 3.1 watts per candle, in a frosted globe. This particular lamp was taken at random from a number of similar lamps which had been in service about 50 hours. No attempt is made, therefore, to present an accurate comparison between the tantalum and carbon types of lamps, but only their general relative behavior. It is possible that, if the carbon filament lamp had been specially selected, its behavior would have been superior. On the other hand, if the tantalum filament lamp had been specially selected from the batch tested, its behavior also would have been superior. The results given in the curves are to be interpretated, therefore, as showing the qualitative relative behavior of the two general types of filament, carbon and tantalum.

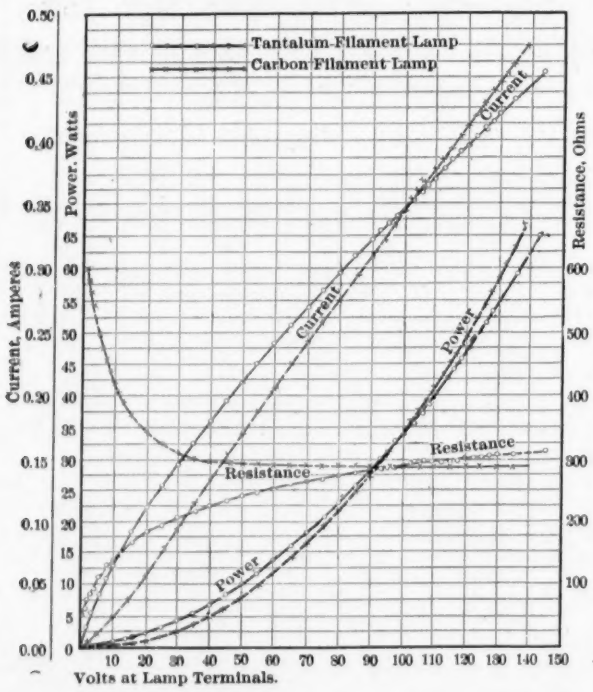


FIG. 1.—ELECTRICAL BEHAVIOR OF CARBON AND TANTALUM FILAMENT INCANDESCENT LAMPS (FROSTED.)

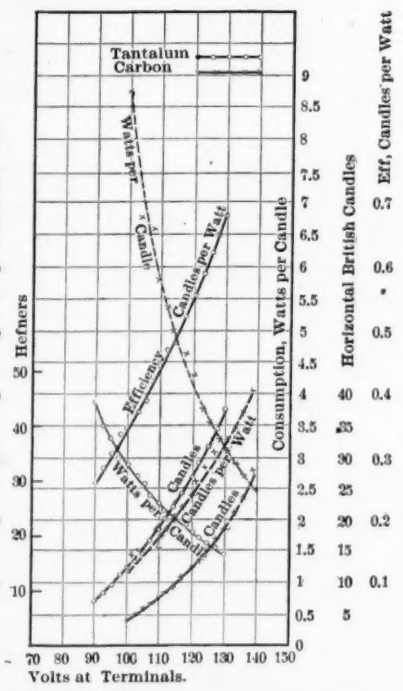


FIG. 2.—LUMINOUS BEHAVIOR OF TANTALUM AND CARBON FILAMENT LAMPS.

Resistance.—The carbon filament (Fig. 1) had an initial resistance of about 600 ohms at the normal room temperature and lowest voltage. As the pressure at the terminals was increased, this resistance fell very rapidly to a minimum of 288.2 ohms at 75 volts, this value being practically constant from 70 to 90 volts. The resistance then rose very gradually to 293 ohms at 140 volts, the highest pressure employed in the test. This curve is characteristic of the ordinary carbon-deposited filament. That is, the resistance of a carbon filament usually reaches its minimum at a voltage lower than the working voltage.

The tantalum filament had an initial resistance of about 55 ohms at the normal room temperature and lowest voltage. It rose rapidly at first and afterward more slowly as the terminal voltage increased. The highest resistance observed was 316.8 ohms at 143.3 volts. The resistance was still rising at this point, as shown by the curve.

Whereas, therefore, the carbon filament falls, under operation, to about half its cold resistance, the tantalum filament rises, under operation, to about five and one-half times its cold resistance. On this account the initial rush of energy into the tantalum filament must be about ten times as great as in the carbon filament. The time allowed for the tantalum filaments to reach its working temperature is, by inference, materially less than for the carbon filament. It would be interesting to investigate, from this standpoint, the possible influence of frequent turning on and off upon the lifetime of the tantalum filament.

Under operative conditions the carbon filament has sensibly constant resistance for the working range of voltages. The tantalum filament increases in resistance about one-fifth of one per cent. per volt increase of terminal pressure, in the neighborhood of its normal working voltage. On this account, a given percentage increase of voltage on the tantalum lamp will not produce the full corresponding increase in current strength. Thus, an increase of terminal voltage of 5 per cent. would increase the current only about 3¾ per cent. Such a property is valuable, since it tends to regulate automatically the current strength passing through the lamp under variations of line voltage. The effect in these tantalum filaments is not, however, very marked at their normal working point, and not so great as the curve shows it would be at a much lower pressure, say at 20 volts. Here an increase in voltage of 5 per cent. would cause an increase in current of only 2¾ per cent.

Current Strength.—The curve of current strength in the carbon filament is not far from a straight line through the origin. The corresponding curve in the tantalum filament starts rapidly, but droops considerably owing to the increase of resistance. The slope of the current is greater finally in the carbon filament than in the tantalum, by about one-third. This is due to the self-regulating property referred to under resistance.

Power.—The power in the tantalum filament is decidedly greater, relatively, at low voltages and less at high voltages than in the carbon.

Candle-Power.—The tantalum lamp became appreciably luminous at a terminal e.m.f. of 9.5 volts, or about 9 per cent. of its normal working voltage. The carbon filament became luminous at 24 volts, or about 20 per cent. of its normal voltage. Thus a tantalum filament will begin to glow at a much lower voltage than the corresponding carbon filament. This may prove a useful property in testing and the like.

The curves of Fig. 2 show that the horizontal candle-power of the tantalum lamp is markedly greater than that of the carbon lamp. The luminous efficiency, or candles per watt, of the tantalum lamp is also markedly greater than that of the carbon lamp tested. (It may be noted here that the globes of both lamps were frosted.) Thus at 110 volts the tantalum lamp consumed 2.2 watts per candle, while at 120 volts, the normal for the carbon lamp, the latter con-

sumed 4.3 watts per candle. The normal efficiency of the frosted tantalum lamp was, therefore, nearly double that of the frosted carbon lamp. We have no knowledge as to the relative duration of life for the two types at these efficiencies.

A small change of voltage produced a somewhat larger change of the candle-power in the tantalum lamp than in the carbon lamp. Thus an increase of 1 per cent. in normal voltage produced 0.7 candle increase with the tantalum lamp, and 0.6 candle with the carbon lamp. The lamps were, therefore, nearly alike in the increase of candle-power for a given small increase in voltage, but as will be seen from the curves, the relative behavior in this respect would change appreciably with a shifting of the chosen working voltages. Consequently not much stress can be laid on this comparison. Since, however, the candle-power of the tantalum lamp was considerably greater than that of the carbon lamp, it is evident that if equal small increase in voltage produces equal increase in candle-power, the percentage of increase will be markedly less in the tantalum lamp.

Distribution of Light.—With frosted globes the change in horizontal candle-power with change of azimuth was negligible in the tantalum lamp. This would be substantially true in an unfrosted lamp, owing to the cylindrical disposition of the filament. In Fig. 3 is given the observed distribution of tantalum lamp No. 2 in a vertical plane. At the tip the candle-power falls to about 6, the horizontal value being 18.6. The mean spherical candle-power was 13.55, which gives a spherical conversion factor of 0.73. The vertical distribution of the tantalum lamp is nearly the same as that of the common type of carbon filament lamp.

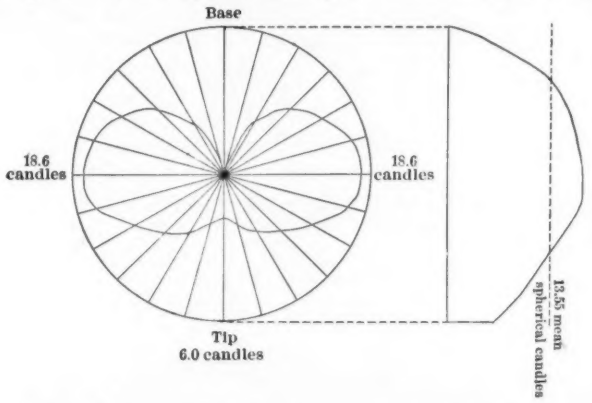


FIG. 3.—LUMINOUS INTENSITY OF TANTALUM LAMP IN VERTICAL CIRCLE, AND ROUSSEAU DIAGRAM OF SAME.

The following table shows a comparison of the ten tantalum filament lamps in regard to uniformity of candle-power and consumption at the nominal voltage, 110.

Lamp number.	Current, amperes.	Power, watts.	Horizontal candles.	Specific Consumption, watts per candle.
1	0.358	39.35	18.45	2.13
2	0.369	40.56	18.60	2.17
3	0.365	40.20	19.80	2.06
4	0.373	40.98	19.20	2.13
5	0.369	40.56	20.60	1.97
6	0.360	39.68	18.96	2.09
7	0.366	40.30	18.80	2.14
8	0.367	40.40	19.90	2.03
9	0.360	39.55	18.65	2.12
10	0.367	40.32	19.05	2.12
Mean	0.3654	40.19	19.20	2.10

Recent Electrochemical Developments.

ELECTRO-CYANIDE PROCESS.

Electro-cyanide processes are either carried out in two distinct steps—the gold in the ore being first dissolved in leaching vats and subsequently precipitated by electrolysis in other vats—or the solution of the gold and its precipitation are carried out simultaneously in the same apparatus. Though all the processes which have so far been successful on a large scale—like the Siemens & Halske process—belong to the first class, yet it is evident that a process of the second class, if practical at all, would be much preferable on account of the greater compactness of the plant and a considerable reduction of the time of treatment. Most inventors, therefore, are working in this direction, the latest process of this kind being described in a recent patent of E. L. Oliver.

Fig. 1 shows a vertical section and a cross-section of the apparatus. The cross-section shows the arrangement of the electrodes. In the centre of the tank is a pipe, *D*, rising to the upper portion of the tank and being connected at its lower end with a casting with openings in its sides. *C* is an air-pipe leading from an air-compressor; it enters through the bottom discharge, *B*, of the tank and rises into pipe *D*. In the upper part of the tank are the electrodes, *E* and *F*; they are in great number to give extensive surface. The cathodes are amalgamated copper plates which are automatically supplied with mercury while in use.

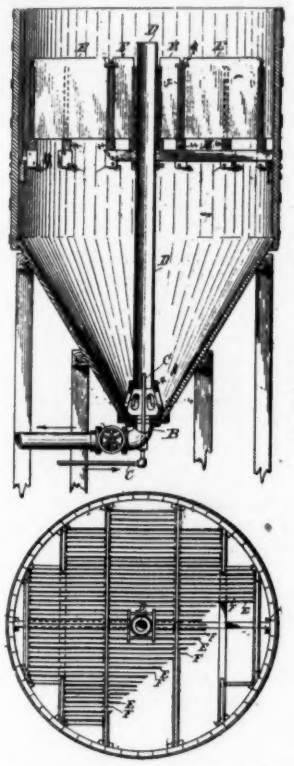


FIG. 1.—APPARATUS FOR ELECTRO-CYANIDE PROCESS.

The operation is as follows: The material to be treated and the cyanide solution fill the tank above the level of pipe *D*. Air is then turned on through pipe *C*. The effect is to lighten the column of the mixture in pipe *D*, whereby a continuous circulation of the mixture upwards through pipe *D* and then downwards between and past the electrodes and to the bottom of the tank and into the pipe *D* again. By the electric current the gold and silver are deposited on the amalgamated copper plates *F*. This agitation and circulation of the mixture can be regulated by the compressed air supply to be as gentle as desired, and though the material makes contact with the plates *F*, there is no scouring of the plates.

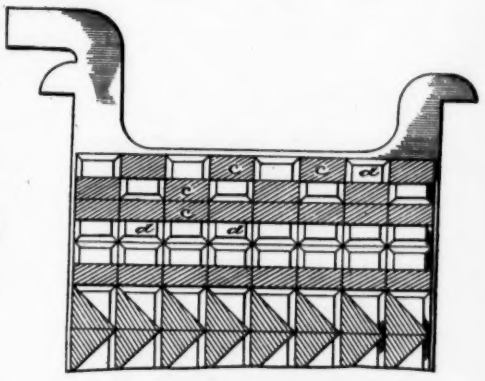


FIG. 2.—STORAGE BATTERY CONSTRUCTION.

BATTERY INVENTION.

A patent granted to P. Seeliger, of Hagen, Germany, and assigned to the Electric Storage Battery Company of this country refers to the method of adding certain chemically inactive substances, like finely-divided carbon or china-clay, to the active material in manufacturing spongy lead electrodes. Such an addition results in an expansion of the active material during the use of the plate. This expansion may continue until the original volume has been doubled or more, and by this action the loss of capacity of the negative plates during their life is prevented. But if the active material thus expands outward from the grid, it gradually looses contact and may, in a short time, all fall off and leave the grid bare. In order to avoid this defect, Seeliger encloses the active material within perforated plates, retaining-sheets, or grating, as of metal, rubber or other comparatively inactive material, and fills the receptacles only partly with active material, so that ample room is left for future expansion. Fig. 2 shows a grid with half-filled spaces before being covered with the perforated sheet. The active material, *c*, will in time expand and will be forced by the perforated cover to grow into the empty spaces *d*, thus filling up gradually the whole of the box which it occupies.

A patent granted to E. A. Sperry refers to the construction of large electrodes, as used in central stations. Such electrodes are subject to rapid deterioration on account of the change in volume of the active material which bends and distorts the grid or support. Sperry constructs separate sections, each of which is secured to the frame at its upper edge only, leaving spaces between its side and bottom edges and the frame. Each section is enclosed in an envelope of a pyroxylin fabric and is retained in the frame-opening by lugs which extend from the frame. Each of the electrode-sections is thus free to buckle without bending the frame-bars.

A patent granted to H. F. Hobel intends to increase the active surfaces of storage batttry electrodes by the reduction or compres-

sion of the strips or plates forming the electrodes. His method of manufacture consists in forming laterally-projecting ribs in the metallic body, filling the space between the ribs with active material and then forcing the body through the die of a reducing press.

Two patents were granted to U. D. Foster and A. F. Landen, respctively, for details of construction of small medical batteries.

MISCELLANEOUS.

The scale which is removed from ingots of calcium carbide produced in the Horry and other commercial electric furnaces is a refuse product. The presence of carbide and graphite, as well as unconverted lime and carbon in the scale gives it a very low and irregular electric conductivity so that it is commercially impracticable to resmelt it in the usual manner. The content of carbide is also troublsome on account of its reaction with the moisture of the air, with a resulting generation of acetylene and an explosive mixture of acetylene and air in the supply hoppers and chutes. In a patent recently granted to J. R. Edmands and J. Scales it is proposed to first crush the scale and treat it with sufficient water to decompose the carbide in it. The residue is then dried and smelted in the usual carbide furnace, sufficient carbon being added to make the total carbon contents of the mixture equivalent to its lime contents.

A patent granted to B. F. Gardner réfers to the composition of an electric resistance material for use in heaters, rheostats, controllers, etc. It consists of a vulcanized and carbonized mixture of graphite, carborundum, sulphur and India-rubber or gutta-percha.

When a circuit containing a reactance and carrying a direct-current is broken, the reactance produces an e.m.f. in the same direction as the current which is interrupted. This may result in an arc at the break. In order to furnish a path for the current due to the inductive e.m.f., W. S. Horry proposes to shunt the reactance by an electrolytic cell with one aluminum electrode in such a way that the aluminum electrode permits the passage of the current due to the breaking, but not the passage of the ordinary supply current.

A. Wright patents details of construction of mercury electrolytic meters, G. W. Clough a rotating drum for electroplating shops. Within the drum is a spiral carrier attached to and rotating with the drum, the turns of which form a continuous channel, by means of which the articles to be plated are conveyed from one end to the other. The speed of rotation of the drum determines the thickness of the plating.

New Telephone Patents.

INTERCOMMUNICATING SYSTEM SWITCH.

A self-restoring dial switch for intercommunicating systems has recently been patented, the principle of operation of which is so simple and self-evident that it is surprising that it has not been earlier used. The handle upon the end of the dial arm serves as the receiver support. This not only tempts the user to restore the switch when hanging up the receiver, but if he forgets, the weight of the receiver will rotate the arm to the zero position. The patent for this switch has been granted to W. H. Rose of Catonsville, Md.

PARTY LINE SYSTEMS AND DEVICES.

The party line is probably under discussion as often as any other one telephone feature, and the variety of treatment it receives at the hands of inventors is at first sight surprising. When, however, the subject is gone into a little further a reason is apparent. In some localities the party line in every present form is viewed with suspicion. In others, when the cost of line is very high compared with the cost of the other features of service, it is considered the salvation of the telephone managers. Again, in the farmer districts, it is absolutely essential. Couple these conditions with the additional fact that almost every farmer has his own idea as to how his line should work, and the variety of improvements is explained.

We have at hand for present consideration five patents for party line devices. In this case, strange to say, all but one point to the obtaining of secrecy, or, in other words, are for "lock-out" features.

One of the systems is the invention of G. Babcock, of Chicago. This is a step-by-step system. Mr. Babcock has found that in the usual lock-out systems when one side of the receiver circuit is open, it is possible at times in spite of this to overhear conversations. The chief feature of his system is a locking out by short-circuiting the receiver at non-wanted stations. He has assigned his patent to the Stromberg-Carlson Company.

E. A. Buell, of De Kalb, Ill., has also produced a lock-out step-by-step system, but he has as an additional feature an ability of the various stations on any one line to call each other without calling central. In this system, assigned to the Selective Signal & Telephone Company, any number of stations may be given simultaneous access to the line and to the exclusion of the others, this being under the control entirely of those having the right of way.

Messrs. J. M. Beever, of Effingham, Ill., and A. W. Hammer, of Willow, Ind., each with his own devices, depend upon manually-operated switches to control the lines. These switches are arranged so that if two stations desire to converse they cut the line in three segments, two end and a middle. The middle segment lies between and terminates at the two stations. The two end segments are the outlying portions. These may be used independently of and simultaneously with the middle segment. Obviously, no stations on the end segments can listen in, and as to those of the middle, if any attempt to do so, this segment becomes cut at the station of the "eavesdropper." He thus may be detected and ordered off the line.

The last device is a switch for simplifying the connecting in of stations on complicated selective systems, in which selection is obtained through special split windings of bells or relays and the relation of these to the two limbs of the line and ground. Messrs. C. M. Jacobs and A. H. Nicholson, of England, the patentees, provide a sort of commutator switch to which line ground and coils may be permanently connected and an instrument may be set to respond to any current combination by the simple introduction of a code key upon the commutator.

MESSAGE REGISTER SYSTEM.

In Fig. 1 is shown the circuits of a message registering system invented by H. M. Crane, of New York, the patent being assigned

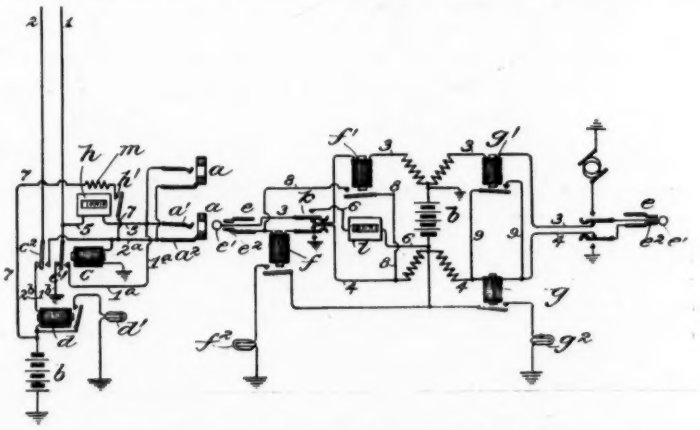


FIG. 1.—CRANE MESSAGE REGISTERING SYSTEM.

to the Western Electric Company. It will be seen that the system is worked out for the two-wire central energy switchboard. The features are those of the present Western Electric message counting system, in that each operator has a register common to all the cords, each subscriber's line has a register of its own, and in that these are so interconnected that the line registers in operating cause a signal to be displayed to indicate all functions properly carried out. The control of a count lies in the key, *p'*. When this is depressed, the cut-off relay, *c*, is shunted, and its armature falls back, removing a shunt from the line register. At the same time the register circuit is completed. When the line register operates, an auxiliary circuit becomes closed through its contact to give the O. K. signal through the agency of relay *f* of the cord circuit.

RECEIVERS.

A new receiver has been patented by A. R. Thollander, of Chicago. In this receiver the magnetic system is carried by a cup, which is clamped by the mouthpiece. This cup completely isolates the air space behind the diaphragm from the column of air in the handle portion. The object of this is the avoidance of any resonating effects of the air column. A novel feature lies in the means of adjustment, a single screw sufficing to advance the whole magnetic system toward the diaphragm, or to withdraw it.

A receiver constructed so that there is provided an adjustment between the diaphragm and poles, but in which all working parts are mounted upon metallic supports, is the subject of a patent issued to William Kaisling, of Chicago, and assigned to the Stromberg-

Carlson Company. In this receiver a metallic cup is provided, having a tubular extension from its base. This extension is threaded inside and out. The magnetic system is arranged to screw into the extension, an adjustment between the relative positions of the edge of the cup and the faces of the poles being thus obtained. To secure these parts after adjustment is effected, a locking device is provided. The receiver cap screws down over the metallic cup, clamping the diaphragm. The casing or handle can then be put in place, the outer threads of the extension from the base of the cup engaging threads within the handle in a manner to draw it up against the

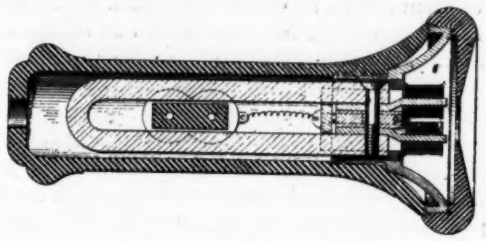


FIG. 2.—KAISLING RECEIVER.

shoulder of the rubber cap and thus concealing and insulating all working parts. Fig. 2 gives a sectional view of this receiver.

AUTOMATIC EXCHANGE.

N. E. Norstrom, of Junction City, Kan., has been granted a patent for an automatic exchange system. The system is of the multiple switch type, each line having its own machine, carrying contact wipers, trailing over a contact panel upon which every other line is represented. The contacts are arranged upon the usual co-ordinate basis. A novelty of the system is the method of sending in a number. The first or highest digit is sent in by the usual slow movement of the pointer across a dial. The second digit is sent in by rotating the dial hand one complete revolution for each unit. The last digit is forwarded like the first. The exchange mechanism comprises a number of guides, one pair over each vertical row of contacts. Cross-heads carrying wipers move upon the guides, the moving power being applied through racks attached to the cross-heads. The first act of switching causes an intermeshing of the proper rack with its driving gear. The other steps merely suffice to determine the degree of motion of the cross-head.

SWITCHBOARD CIRCUITS.

Three sets of circuits for manual central energy boards have been recently patented. Of these, two relate to a two-wire system adapted for selective party lines, which require ringing on both sides of the various lines. With such systems it has been found difficult to keep the cut-off relays from chattering, and it is the purpose of the present inventions to so organize the circuits that the cut-off relay is removed from the influence of the ringing currents. Both these patents have been granted to H. G. Webster and by him assigned to the Stromberg-Carlson Company.

The third patent deals merely with extensions of the "anti-click" system recently patented by W. M. Davis, of Chicago, and noticed herein a few weeks ago.

HYGIENIC RECEIVER CAP.

Louis Sternberger, of Brooklyn, N. Y., has obtained a patent for a soft rubber cap adapted to be stretched over a receiver. This cap not only can be removed for cleaning, but is soft and springy. It is made hexagonal to prevent the receiver from rolling when laid down.

AN ODD TRANSMITTER MOUTHPIECE.

An odd elongated mouthpiece for transmitters has been patented by W. R. Kimball, of New York. This is a large tube, one end of which fits against the regular mouthpiece and the other end of which is shaped to the face of the user. The end engaging the regular mouthpiece is sealed save for a central opening through which a tube passes. This tube forms the connection between the two mouthpieces, and it extends well into the auxiliary mouthpiece. From the side of the small tube a pressure outlet is made to which is connected a rubber tubing of considerable length. Inside the large tube and surrounding the central tube are a large number of small tubes completely filling the space and used to break up any effects of resonance. The object of the auxiliary mouthpiece is secrecy, it being possible with its use to completely cut off escape of any sound.

LETTER TO THE EDITORS.

"Unipolar" and "Autopolar."

To the Editors of Electrical World and Engineer:

SIRS:—Referring to the term "unipolar induction" (pp. 228, 250, 251, February 4, 1905), I beg to call your attention to the word "autopolar" as a substitute for "unipolar." The latter word, which seems to have the advantage both from the standpoint of physics and philology, I proposed in the *Philosophical Magazine* several years ago (March, 1899). "Autopolar induction" means induction by one and the same pole all the time, in contradistinction from "heteropolar induction," where both the poles work alternately. Thus the ordinary constant-current dynamo is a heteropolar induction machine, while that based on Faraday's early experiment is an autopolar induction machine.

The words "autopolar" and "heteropolar" have been adopted by the editors of the "International (English-French-German) Technolexicon, which is now under preparation.

ROTTERDAM, HOLLAND. J. J. TAUDIN CHABOT.

DIGEST OF CURRENT ELECTRICAL LITERATURE

DYNAMOS, MOTORS AND TRANSFORMERS.

Alternating-Current Series Motor.—NEWBURY.—An illustrated article on the action of the neutralizing field winding in the alternating-current series motor of the Westinghouse Company. By the addition of this winding it was possible to get as good an operation of the series motor at 25 cycles as before at 16. The power factor of the motor depends upon the relative values of the inductive and energy components of the total voltage required for the operation of the motor. The self-induction of the armature winding is due to magnetic flux which serves no useful purpose, and it is not essential to the operation of the motor; decreasing the self-induction of the armature winding is, therefore, the best method for increasing the power factor. Through the action of the commutator the armature winding of a series motor (whether supplied with direct or alternating current) is in its magnetic effects equivalent under all conditions of operation to a number of stationary coils, whose positions are determined by the position of the brushes. With the brushes in their usual position one of these equivalent stationary coils is located as shown diagrammatically in Fig. 1. The armature self-induction can be neutralized by adding a stationary winding to the motor so placed and connected in the motor that it produces a magnetic field approximately equal in amount and opposite in direction to the magnetic flux generated by the current in the armature winding. The position of this winding in the motor is shown in Fig. 2 and

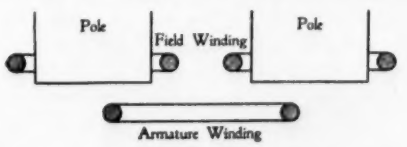


FIG. 1.—ALTERNATING-CURRENT SERIES MOTOR.

its connection in the circuit is shown in Fig. 3. From the relative positions of the different windings as shown in Fig. 2, it is seen that neither the armature winding nor the neutralizing field winding can have any inductive effect on the field winding, i. e., there will be no mutual induction between the field winding and the other windings.

As actually constructed, the neutralizing winding is wound through slots in the poles and distributed in a number of slots in order to

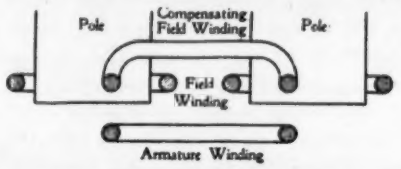


FIG. 2.—ALTERNATING-CURRENT SERIES MOTOR.

approach the distribution of the armature conductors. Several illustrations show this construction. The author also gives diagrams

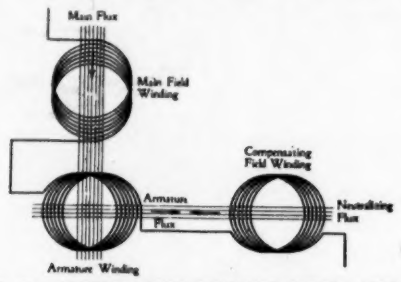


FIG. 3.—ALTERNATING-CURRENT SERIES MOTOR.

representing the action of the motor.—*Elec. Club Jour.*, March.

Parallel Operation of Dynamos Having Different Characteristics.—LYNDON.—An illustrated article on the compounding of generators for the purpose of maintaining a practically constant voltage at the end of the feeders. Theoretically, the compounding is adjusted so that the increase in dynamo voltage produced by the magnetizing effect of the main current which flows through the series coils is just equal to the increase in feeder drop, due to the increase of current flow. In this way the volts due to the compounding effect of the series windings are always equal to the volts of drop in the feeders. By the term "compounding effect" is meant the effect of increasing the voltage at full load above the voltage at no load; the compensation for internal losses in the generator—which requires some of the magnetism of the series winding—is not taken into consideration. The author shows that where a number of generators are run in parallel there is a certain number, only, of the machines in operation with which the increase of voltage due to compounding is equal to and neutralizes the feeder drop. If the number of machines in parallel differs from this number, the desired equality between voltage increase and drop no longer exists. The author shows in numerous examples how the total current is exactly divided among different machines in proportion to their respective capacities when the characteristics of the several machines differ.—*Am. Elec.*, March.

Single-Phase Motor.—An illustrated account of a condensing plant driven by a Fynn repulsion induction motor. The motor is of 14 hp with an overload capacity of about 40 per cent. Of special interest is the fact that the supply frequency is as high as 75 periods per second, and that nevertheless the commutation is perfect under all conditions. The starting current is just about equal to full load current, and it is said that with a frequency lower than 75 periods per second, it would be possible to reduce this starting current materially. The efficiency guaranteed was 83 per cent., but as a fairly high power factor, i. e., 80 per cent., was subsequently demanded, the efficiency fell slightly below the figure named. The efficiency and power factor are almost constant from 9 hp to 20 hp. In the larger sizes of Fynn motors, from 50 hp upward, including traction motors, the Fynn method of self-excitation is provided.—Lond. *Elec.*, February 24.

Eddy Currents.—PICOU.—Continuation and conclusion of his serial on eddy currents with applications. He discusses eddy currents produced in primaries and secondaries of dynamo electric machinery, the eddy currents generated in the pole shoes facing slotted armatures, and the eddy currents due to the commutation in direct-current machines. Some numerical examples are added.—*L'Industrie Elec.*, January 25 and February 10.

Design and Construction of Small Dynamos and Motors.—POOLE.—Another in the series of design articles, the present one treating of the commutator and brush holders.—*Am. Elec.*, March.

LIGHTS AND LIGHTING.

Incandescent Lamps.—Some notes on a British factory of incandescent lamps and on their "Wytelite" lamp, which burns with a much whiter light than ordinary incandescent lamps, and is, for this reason, especially suitable for lighting shop windows, etc. It is to all intents and purposes an ordinary glow lamp, but overrun to obtain whiteness of the filament. In order to make the consequent increase in temperature possible without decreasing the life of the lamp or effecting a premature blackening of the bulb, the glass globe is perfectly circular in shape and considerably larger than an ordinary bulb. In this way a greater radiating surface is obtained which does not show the effect of blackening so readily as the small ordinary bulb. It is stated that the lamp is made for all voltages, has a useful life of from 800 to 1,000 hours, an efficiency of from 3 to 3¼ watts per candle-power, an illuminating power of from 20 candles to 25 candles in a horizontal direction and from 40 to 50 candles in a vertical direction. The globe is partially frosted.—Lond. *Elec.*, February 24.

Nernst Lamp.—SALOMON.—An illustrated paper presented before the Vienna Electrical Society. Most of the information given is well known. The author exhibited a 500-volt lamp which consumes about one watt per candle-power. The company is still making experiments with this lamp, but the author is convinced that this new type will be quite successful and that the 500-volt lamp will be especially useful for street lighting and for direct connection to railroad circuits. The German company manufacturing the Nernst lamp has made so far more than 3,500,000 lamps.—*Zeit. f. Elek.* (Vienna), February 26.

Arc Lamps.—An illustrated summary of improvements in electric arc lamps, the descriptions being taken from recent German patent specifications.—*Zeit. f. Beleucht.*, January 30, February 10 and 20.

Lighting of Machine Tools.—An illustrated description of fittings for lighting of machine tools in such a way that the incandescent lamp may be held in the best position with relation to the tool.—Lond. *Elec.*, February 17.

POWER.

Fuel Economy in Steam Power Plants.—BOOTH AND KERSHAW.—The conclusion of their British Institution of Electrical Engineers paper, the first parts of which were recently abstracted in the Digest. Concerning superheating the authors say that superheating should be considered as one of the final stages of dry steam production, the actual final stage being the cooling of the steam to saturation temperature by means of the heat absorptive effect of the cylinder walls. Superheating is necessary to economy because cylinders are not adiabatic. With superheated steam, cylinders are nearer to adiabatic conditions. Concerning the waste gases, the authors state that the temperature and chemical composition of the waste gases passing from every large boiler plant, ought to be regularly ascertained, the work being carried out by a man specially trained in technical gas analysis. The absence of smoke is no guarantee that combustion is being carried out in an economical manner, and only by constant testing of the exit gases can one be certain that the fuel is being burned without undue excess of air. Concerning draught they say that a good draught is an aid to economy only when other conditions are good. In summing up, the authors point out that the best results can be attained only when scientific methods of control are employed in relation to feed-water fuel, waste gases and draught. Automatic apparatus for testing flue gases or any other product can never take the place of the trained chemist; for an automatic apparatus demands not less but more skill in its control and management than ordinary apparatus, if the records obtained by it are to be of permanent value. The results now being obtained by CO_2 recorders in many electricity works are, in the authors' opinion, of doubtful value, owing to the lack of trained assistance in their management. Automatic apparatus of all kinds is of great service, but not in the direction popularly supposed. It enables one skilled and efficient man greatly to increase the number and extent of his duties, and practically to treble or quadruple his efficiency; but it does not, and cannot, give accurate and valuable records when placed in the hands of untrained men. They finally give some rules for sampling fuel.—Lond. *Elec.*, February 17; an abstract of the discussion which followed the paper is given in Lond. *Elec.*, February 24.

Power in Mines.—HENSHAW.—A discussion of the use of electric power for mine operation, compared especially with its chief rival, compressed air. The author thinks that the best practice to-day may be found in the combination of air and electricity. The air power system owes its existence in mines to the percussion drill. Electric power is not well adapted to develop reciprocating motion for rough

work. The simple and rugged construction possible in a piston drill, and above all the elastic steam or air cushion, gives these agents great advantage over electricity. A number of electric percussion drills have been and are made, using either solenoids to develop reciprocating motion or converting rotary motion of motors to reciprocating by mechanical means. One form of the latter type might be considered electro-pneumatic, the drill piston being actuated by compressed air delivered by what may be called the motor-driven piston. The advantage of permitting the adoption of a single agent for all power distribution, and its high efficiency, are in favor of the electric drill; but in simplicity, strength to withstand rough usage, and general reliability, the air drill still holds its own. It is doubtful if the electric drill can be made to compete with the air drill strictly on its own merits, but at the same time it hardly seems to have received all the attention it deserves. From the nature of electric power, one would look for improvements in the direction of rotary drills. With the exception of the rock drill, however, the author favors the use of electric power in mines. He briefly discusses the danger from electric sparks in gaseous mines.—*Eng'ing Mag.*, March.

Electricity in Mines.—A reprint of the special rules which have been prepared by the Home Secretary for the installation and use of electricity in coal mines in England and which are to be observed as far as is reasonable and practicable.—Lond. *Elec.*, February 24.

Purification of Greasy Condensation Water.—An illustrated description of a condensation water purifier in which it is claimed that the mechanically-suspended and emulsified oil is completely removed by a system of coagulation and filtration.—Lond. *Elec.*, February 24.

Chemical Purification of Boiler Feed Water.—WALSH.—An article on the economy secured by the purification of boiler feed water.—*Am. Elec.*, March.

TRACTION.

Automobiles.—PERISSE.—A well-illustrated paper on the latest types of industrial motor vehicles. The author sums up the present situation in Continental Europe and especially in France. He makes the following remarks on electric automobiles: The number of electric automobiles employed in France is limited to the city delivery wagons of establishments such as the Louvre and the Bon Marché, which are placed on an ordinary electric carriage chassis. Electric vehicles for industrial purposes, in fact, have not come into use even where power could be obtained at very low cost, partly because the dead weight is considerable—larger even than in the steam vehicle—and partly because the maintenance of modern accumulator batteries is very burdensome, especially in the case of vehicles subject to the vibration, the jolting, and the shocks of city street travel. Nevertheless, the Société des Automobiles Krieger and Milde & Co. build delivery wagons which give excellent service in any case in which the rather high running expense is offset by the advantages of the very smooth running of the vehicle. The Krieger Company also has a gasoline electric truck, that is, one in which a gasoline motor drives a dynamo from which current is distributed to motors driving each wheel. The generating set may be used for operating a large searchlight when the truck is at rest. The Paris post office also introduced in 1904 a large number of high-speed vans for the rapid handling of the mails within the city. In brief, the construction of electric automobile vehicles has reached a point of such perfection that they may be employed with entire safety for delivery wagons up to 3½ tons total weight. Beyond that the internal combustion motor type becomes the most advantageous.—*Eng'ing Magazine*, March.

Testing the Resistance of Steel Rails.—A note on a new testing panel made by an English company for ascertaining rapidly the resistance of track and conductor rails. The resistance is ascertained by passing a known current through the rail and measuring the drop of potential across a given length, the resistance being obtained by Ohm's law.—Lond. *Elec.*, February 24.

Automobiles.—An illustrated account of the motor car exhibition recently held in London.—Lond. *Elec.*, February 17.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

India.—Two illustrated articles on Indian electric light and power plants. The first refers to the plant of the Nilgiri cordite factory, which is supplied with energy from the Carteri Falls some three and one-half miles distant. There are four three-phase generators, each of 125 kw, the voltage being 5,000 between any two terminals of the star-wound armature and two smaller direct-current machines for excitation. At the cordite factory the transformers receive current at 5,000 volts on the high-tension side, mesh-connected, and give 380 volts on the low-tension side with star connection, the pressure between any one phase and the neutral point being 220 volts; this is the pressure used for lighting the factory. In the transformer house choking coils have been placed in the neutral wire circuits, so that the pressure can be regulated on the different branches of the lighting circuits as required. The cables in the factory are underground. The three-phase induction motors used throughout the factory are 18 in number, and consist of seven of 45 hp, two 28 hp, four 18 hp, and three 3 hp, the larger motors running at 800 r.p.m., less slip, and the 3-hp and 6-hp at 1,200; all the motors, except the 3-hp, are provided with starting resistances in the rotor circuits. Smith describes the electric light trust of Dacca, a large town in Eastern Bengal. The system is identical with that of Calcutta—a three-wire, direct-current supply with batteries, carrying a pressure of 500 volts between the outers, and having the middle wire earthed. For the purpose of balancing, three separate means have been provided, which may be used either individually or in combination: First, the regulating cells of the batteries; second, a couple of steam dynamos in series, one on each side of the system; third, a motor-generator or balancer proper, which may be used at the same time for boosting up the pressure on the charging circuit of the batteries, and may be on this account more correctly styled a balancing booster. These are all installed on the premises of the power station, and regulated from the same board.—Lond. *Elec. Rev.*, February 17.

Electromagnetic Relay for Voltage Regulators.—THIEME.—Automatic regulators which are mostly used for maintaining constant voltage at the bus-bars or at a feeding point need a relay to be operated. The author describes the following new arrangement for direct current, which is illustrated in Fig. 4. + and — are the two

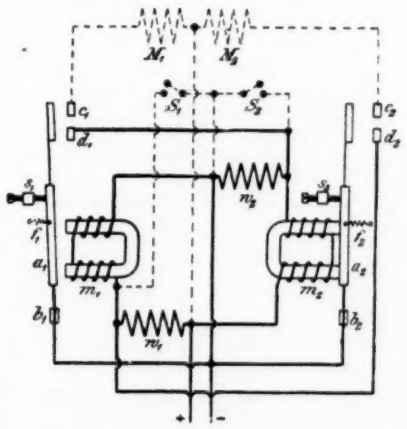


FIG. 4.—ELECTROMAGNETIC RELAY.

points where the voltage is to be held constant. m_1 and m_2 are two electromagnets and the resistances, w_1 and w_2, are inserted between the points + and — and the windings of m_1 and m_2, respectively. m_1 is the magnet which is intended to close a contact when the voltage becomes too high. m_2 is the magnet which shall close a contact when the voltage becomes too low. The position of the different parts of the apparatus shown in the illustration is for normal voltage. The armature, a_1, is in this case not attracted by m_1, and is pressed by means of the spring, f_1, against the screw, s_1, so that the contact, $c_1 d_1$, is broken. The armature, a_2, is attracted by m_2 and rests against the screw, s_2, while the spring, f_2, tries to draw it back. The contact, $c_2 d_2$, is therefore, also broken. Rough adjustment is made by means of varying the tension of the springs, f_1 and f_2, more exact adjustment by means of the screws, s_1 and s_2. The adjustment of s_1 and f_1 determines the highest voltage to which the e.m.f. is permitted to rise; the adjustment of f_2 and s_2 determines the lowest voltage to which it is allowed to fall. Should the voltage rise above the higher limit, a_1 is attracted by m_1 and connects b_1, c_1 and d_1. Thereby the switching device is supplied with current which is assumed to be operated by an electromagnet, the left magnet, M_1, being acted upon in this case. This acomplishes the desired diminution of the voltage and at the same time closes the switch, S_1. The windings of m_1 is thereby short-circuited, so that it is no longer magnetized and the armature, a_1, returns to its normal position, being drawn back by the spring, f_1, the circuit of M_1 being now

interrupted. Thereby the switching device is also brought back to its normal position and the switch, S_1, is again opened and the original condition has thus been reproduced except that the voltage has been reduced, so that the armature, a_1, is no longer attracted. In case the voltage drops below the lower limit, the right hand of the apparatus operates in a similar manner.—*Elek. Zeit.*, February 23.

Liverpool Central Station Account.—An abstract of the Liverpool Corporation electricity supply accounts for 1904. Altogether nearly 29½ millions of kw-hours were sold during the year, 19 millions of which were taken by the tramways, 10 millions by private consumers and the remainder by public lighting. The actual maximum supply demand was 14,093 kw, as against 12,600 kw in 1903, and the number of consumers has increased from 5,084 to 5,639. As a result of the larger number of consumers, the connections to mains, equivalent to 8-cp lamps, have gone up from 525,812 to 583,430. To meet this large increment of customers and connections, no additional generating plant has been installed, however, and the figure, therefore, remains at 24,470 kw. The price charged for lighting, 7½ cents and 6 cents per unit, and the number of public lamps, which is equivalent to 1,469 lamps of 8 cp, have also remained unaltered. For motive power 4 cents to 3 cents is charged, for public lighting 4 cents, and for traction 2.24 cents per kw-hour, with an addition at the rate of 5 per cent. for each 25 cents per ton paid for coal in excess of $1.50 per ton. The total works costs of generating and distributing was 1.146 cent per kw-hour, while the corresponding figure for the previous year was 1.358 cent. The total costs, including management charges, interest and redemption fund, was 3.140 cents, against 3.232 cents in 1903.—Lond. *Elec.*, February 17.

Discriminating Relays and Cut-Outs.—ANDREWS.—A reply to a recent article of Field. He strongly objects to Field's opinion that an alternating discriminating cut-out should be a reverse power relay. He points out that there are conditions which a reverse power relay will not take care of. He especially emphasizes the case that the field of an alternating-current generator, heavily loaded and connected in parallel with other generators, may be open-circuited. In such a case a wattmeter relay would fail to isolate the inactive generator.—Lond. *Elec. Rev.*, February 3. Field replies to this and maintains his original position with some criticisms of Andrews' cut-outs in Lond. *Elec. Rev.*, February 17.

WIRES, WIRING AND CONDUITS.

Lightning Arresters and Safety Devices.—An illustrated description of new safety devices made by a German cable works to prevent excessive rises of voltage. With horn lightning arresters an exact adjustment is difficult in so far as the arc is liable to fuse the ends of the electrodes where they are nearest to each other, and thus produce small points prolonging the terminals and thus diminishing the air-gap. The result is that the lightning arrester may begin to act slightly above the normal voltage. Moreover, with low voltages the horns must be adjusted in such close proximity that especially when they are used in the open air water or snow may settle in the air-gap. To prevent these disadvantages a closely adjustable auxiliary arc-gap is provided, which begins to act at a voltage which may be predetermined with a high exactness. This auxiliary air-gap sends out radiation to the main air-gap between the horns and starts the main arc. Fig. 5 shows the arrangement. The main air-gap, *F*, is made larger than usual. The auxiliary air-gap, *f*, consists of a platinum point and a small platinum plate fixed at the earthed horn. The other horn (which is connected to the line, *L*) is connected with the platinum point through a resistance, *w*. This resistance, *w*, is about 10,000 ohms per 1,000 volts; the object is to reduce the energy required for actuating the auxiliary air-gap to a small value. Another arrangement, which is used especially on mixed lines, consisting of overhead wires in connection with cables, is Zapf's drum. In order to protect the cable against dangerous overvoltages, this drum is provided at the point where the overhead line connects with the underground cable or at a point where the line is connected with machines to be protected; the purpose is that the fault shall be produced at this point. The drum consists of a short length of single conductor cable which is wound on an insulated drum and acts at the same time as a choking coil. The single windings of the earthed lead mantle of this cable are insulated against each other. In the conductor which earths the lead mantle a switch is provided which is opened after the accident has happened until repairs may be made. A third device described is adapted for cables only. It is similar in principle to Zapf's drum.—*Elek. Zeit.*, February 23.

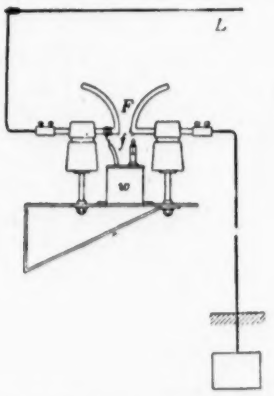


FIG. 5.—LIGHTNING ARRESTER.

Overhead Mains.—ADDENBROOKE.—The conclusion of his paper on overhead mains for electric distribution. He points out that the United Kingdom has a much smaller percentage of central stations in towns of moderate population than the United States, and that the main reason is that in the United Kingdom overhead distribution and a cheap system of wiring are not as usual as in the United States. An appendix gives the extended Italian law for the transmission of electric currents to a distance and the Swiss law on expropriation in the case of electrical works.—Lond. *Elec.*, February 17.

Fault.—An acount of a fault by which the 96 strands of a cable were melted down and mixed with the lead of the sheath forming a lead-copper alloy of remarkable structure, which is shown in several micro-photographs.—Lond. *Elec.*, February 24.

High-Tension Cables.—SCHMIDT.—An illustrated article on the construction and manufacture of high-tension cables with rubber insulation.—*Elek. Anz.*, February 9 and 16.

ELECTROPHYSICS AND MAGNETISM.

Radiation Pressure.—POYNTING.—His presidential address before the British Physical Society. He sums up the advance made in the theory and experimental investigation of radiation pressure. Both theory and experiment justify the conclusion that when a source is pouring out waves it is pouring out with them forward momentum, which is manifested in the back pressure against the source and in the forward pressure when the waves reach an opposing surface, and which, in the meantime, must be regarded as traveling with the train. In the case of total reflection there is a normal force upon the surface; in the case of total absorption there is a force normal to the surface and a tangential force parallel to the surface, while in the case of total refraction there is a normal force which may be regarded as a pull upon the surface or a pressure from within. In any real refraction there will be reflection as well, but with unpolarized light, in the case of glass, a calculation shows that the refraction pull is always greater than the reflection push, even at grazing incidence. An experiment made was described to serve as an illustration of the idea of a beam of light being regarded as a stream of momentum. It showed the existence of the tangential stress due to light incident obliquely on an absorbing surface, the experimental results being in close agreement with the theory. In the solar system these forces may have a considerable value. There is a slightly greater pressure on the advancing hemisphere of the earth than on the receding one, and this appears as a small resisting force in the direction of motion. Through this the particle tends to move in a decreasing orbit, spiraling in toward the sun. As there is good reason to believe that some comets at least are composed of clouds of dust, there is hope that some of their eccentricities may be explained by the existence of radiation pressure. A comet of particles of mixed sizes will gradually be degraded into a diffused trail lengthening and broadening, the finer dust on the inner and the coarser on the outer edge.—Lond. *Elec.*, February 17. The experiment, above mentioned, on the tangential stress due to light incident obliquely on an absorbing surface, is described by the same author in *Phil. Mag.*, January.

Electron Theory of Metallic Conduction.—LORENTZ.—Riecke, Drude and J. J. Thomson have formerly developed theories of conduction of electricity through metals on the basis of the electron theory. The present author attacks this problem by a new mathe-

matical method. He assumes that the metal contains but one kind of free electrons having all the same charge and the same mass, and that at a given temperature the mean kinetic energy of an electron is equal to that of a molecule of a gas. The forces acting upon an electron in a non-homogeneous bar of metal are partly due to the electric field and partly to molecular attraction. The author applies his theory to a number of phenomena, among them the electric conductivity, and the ratio of thermal to electric conductivity. His formulas differ from the older ones of Drude only in the numerical coefficients.—Lond. *Elec.*, February 17; from *Proc. Royal Academy* of Amsterdam, December 24, 1904.

Magnetization and Electrification of Mediums.—EMDE.—A communication referring to the recent article of Sahulka on the changes of energy during the magnetization and electrification of mediums. The author gives several mathematical notes and also refers to the question of what is permanent in a permanent magnet.—*Elek. Zeit.*, February 23.

Röntgen Rays.—BARKLA.—A Royal Society paper giving experiments which prove that Röntgen rays can be polarized and that they consist, therefore, of progressive disturbances taking place transversely to the direction of their propagation.—Lond. *Elec.*, February 24.

Predetermination of Solenoid Characteristics.—PERCY.—An illustrated article, with tables, on the predetermination of solenoid characteristics. The method described is useful in getting at approximate dimensions and excitation and is applicable to "stopped" solenoids.—*Am. Elec.*, March.

ELECTROCHEMISTRY AND BATTERIES.

Production of Ozone.—WOMMELSDORF.—An account of an investigation in which he studied the "noxious charges" which impair the efficiency of influence machines, and which are, therefore, avoided as much as possible by makers of such machines. These become a minimum at a certain distance between the plates, and that distance, therefore, brings about the maximum efficiency. At a certain smaller distance between the plates the loss by the "noxious charges" becomes very large. The external effect of the machine approaches, in fact, to zero, and the electrical work is all done inside the machine. When that occurs, an enormous quantity of ozone is produced by the machine. This indicates a possibility of producing ozone in a much more direct manner than hitherto has been possible. An influence machine can be made into a combined generator, transformer and ozone tube, and it might even be made to act as its own aspirator. It could be enclosed, and the loss of ozone would be reduced to a minimum. It should be possible to generate ozone in a very economic manner.—Lond. *Elec.*, February 24; from *Ann. d. Phys.*, No. 15, 1904.

Light Storage Batteries.—KRIEGER.—A letter with reference to a recent note on the use of a high density electrolyte for storage batteries in order to diminish their weight. He would not use such batteries for general purposes, but if specially great care is taken, they could be used and would have a life of 50 to 60 charges and discharges.—*L'Ind. Elec.*, February 25.

Electrochemical Classification.—VOEGE.—A description of his card index system of classification for an electrochemical bibliography.—*Electrochem. and Met. Ind.*, March.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Type Printing Telegraph.—A fully illustrated description of the recent improvements and modifications of the Murray type printing telegraph.—Lond. *Elec.*, March 3.

Automatic Block Signals.—SCOTT.—Another article in the series on automatic block signals, the present one illustrating and describing complete normal clear circuits, disc signal mechanism and the electrogas signal circuits.—*Am. Elec.*, March.

Electric Clock.—FERY.—An illustrated description of an electrically-driven clock having a free escapement. It is shown in Fig. 6. When the pendulum swings in the direction of the arrow, the ratchet, *B*, attached through *b* to the pendulum, pushes forward the tooth it has caught. The movement is limited by the spring, *g*, which also makes contact for the battery, *F*, and the coil, *E*. The duration of the contact is regulated by the screw, *f'*, attached to the spring, *f*. The magnetized coil, *E*, attracts the armature bob, *D*. On the return swing *B* slides over and *C* is held in position by *g*. This escapement is the same in principle as that used in marine chronometers. The efficiency of the electric motor system is 70 per cent., and a single standard silver chloride cell is capable of driving

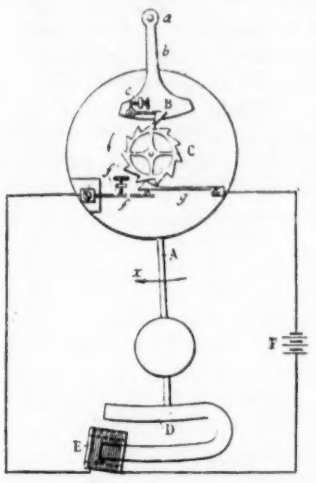


FIG. 6.—ELECTRIC CLOCK.

the clock. The diurnal variation does not exceed 0.3 second.—Lond. *Elec.*, February 24; from *Comptes Rendus*, January 23.

MISCELLANEOUS.

Factory Testing.—WORKMAN.—In a continuation of his illustrated serial on factory testing of electrical machinery, he deals with efficiency and temperature tests of alternators, and describes briefly commercial tests of polarity; iron loss, friction and windage; check on the armature windings and saturation; temperature, and insulation. He gives a diagram showing the connections of a special testing set for use for voltages of 15,000 and over. He then passes over to synchronous motors, pointing out some operating characteristics of the same and describing tests to find the relation of field amperes to armature amperes at unit power factor, and temperature tests.—*Elec. Club. Jour.*, February.

Electric Industries in Germany in 1904.—An abstract of a report stating that the electrical industries in Germany are now recovering and that new avenues are opened for the use of electrical machinery, especially in mines, workshops, agriculture, etc. The Allgemeine Elektricitäts Gesellschaft employs 29,000 men, of which 11,500 are employed in the installing of machines and in the manufacture of rubber goods, steam turbines, gas engines, cables, etc.; 17,500 in the manufacture of electric machines and apparatus. The Siemens-Schuckert Works employ 12,000 men. The total number of employees in the electrical industries in Germany is 72,500. The financial result of the year 1904 has, however, been much less satisfactory than has been expected from the extent of manufacture. The reason is that the prices for electric machines and apparatus had formerly rapidly decreased and could not be raised again during the past year. —*Elek. Anz.*, February 19.

Ignition Devices.—An illustrated description of two new low-tension ignition devices for petrol motor cars, made by French companies.—Lond. *Elec. Rev.*, February 10.

BOOK REVIEWS.

IMPERIAL DIRECTORY AND STATISTICS OF ELECTRIC LIGHTING, POWER AND TRACTION WORKS. Edited and compiled by C. S. Vesey Brown. London: Hazell, Watson & Viney. 1031 pages. Price, 12 shillings 6 pence.

Great Britain is particularly well supplied with directories relating to the electrical industry. In addition to the old-established "Red Book" and "Blue Book," there is Garcke's Manual and the Imperial Directory, which latter is the subject of this notice. The value of the present work lies in the very complete statistics which it gives of all of the central stations and electric railways of Great Britain and Ireland. In the case of the central stations, the information consists of a list of all of the officers, the system of supply, an enumeration of the machinery and distributing system, number of lights, the price of lighting, the capital and revenue accounts for the year and a comparative table showing the progress of the plant. The latter part of the volume gives what information is available concerning the central stations and electric railways of India and the British Colonies.

UNIVERSAL ELECTRICAL DIRECTORY. By J. A. Berly. London: H. Alabaster, Gatehouse & Co. 1,446 pages. Price (duty free) 18 shillings.

The twenty-third annual issue of this valuable directory contains no less than 1,446 pages and 32,751 names and addresses of members of the electrical and allied trades and professions throughout the world, including 7,314 in the section on the United States. Of the other three sections, the British section has 13,533 names, the colonial section 3,744 names and the continental section 8,160 names. The names are entered alphabetically and again under classification by trades, etc., while in the British section they are also again entered geographically.

THE TESTING OF CONTINUOUS-CURRENT MACHINES. By Charles Kinzbrunner. New York: John Wiley & Sons. 326 pages, 249 illustrations. Price, $2.00.

This is indeed a meritorious work, and shows the result of well-directed care in its preparation. Only standard machines and standard methods of testing are treated, but these are handled thoroughly and consistently. The separate parts of the book are well balanced, the requisite amount of space being devoted to each branch of the subject. Seventy pages of the volume are employed for discussing the various testing instruments and their uses. Under characteristics only series, shunt, compound and differential wound machines are dealt with, and no unusual or freak connections are considered. Several modified forms of Prony brakes are described for finding efficiencies by mechanical measurement, while the "separation of losses" and "loading back methods" are treated as being preferable on account of accuracy of readings and ease of control of conditions of test. The report of the Standardization Committee of the American Institute of Electrical Engineers concerning continuous-current machines is given as furnishing an excellent guide as to conditions to be fulfilled by the machines.

DYNAMO, MOTOR AND SWITCHBOARD CIRCUITS. By W. R. Bowker, C.E. London: Crosby, Lockwood & Son. 111 pages, 109 illustrations. Price, $2.25.

The title of the volume indicates its contents. It deals with the subject pictorially, theory and mathematics being practically excluded. The author has exercised care in the selection of the diagrams, which are systematically arranged and briefly described. The introductory section of the book, which was intended to give certain information in a condensed form so as to make the succeeding sections clear and easily understood, needs revision by elimination, since a portion of it is misleading. There is a confusion of "average" and "virtual" values of current and e.m.f. It is stated that "In an alternator the voltage in the outside circuit does not reach either the maximum or minimum amount which it attains in the armature, but rather an 'average' value." One is told to divide the "maximum" value of the actual power by the apparent power to get the power factor. He is informed that self-induction decreases the current, while capacity increases it. It is intimated that induction motors are polyphase machines, while single-phase motors are synchronous machines, which inherently operate without phase difference between voltage and current. The alternating-current circuit diagrams, with a few exceptions, are correctly drawn, so that the inaccuracies in explanations as to alternating-current phenomena do not affect the main portion of the book. With direct-current circuits the author is evidently somewhat more familiar, and the diagrams relating thereto seem to be entirely trustworthy.

THE ELECTROMAGNET. By Charles R. Underhill. New York: D. Van Nostrand Co. 155 pages, 67 illustrations. Price, $1.00.

The contents of this book may be looked upon as the best to be found in its particular branch of engineering. The author, formerly chief electrical engineer of the Varley Duplex Magnet Co., has had the assistance of Townsend Wolcott, A. E. Kennelly and Richard Varley in the preparation of the book. The subject matter is systematically arranged and presented in an attractive manner. The information on the design and construction of electromagnets is especially valuable, since it has been obtained from actual practice. The text is exceptionally free from errors in statements, nothing more serious than apparently a slight discrepancy between the author's words and his thoughts being noted in an instance or two. His meaning is evident when he states "746 watts equals one horsepower, or $hp = 746\ w$," but equations thus expressed do frequently mislead those who follow them blindly. The statement on page 127, "If a wire be passed through a magnetic field at an angle to the lines of force, a current of electricity will be generated in the wire," is quite similar to many others found in various treatises on electrophysics when explaining the generation of e.m.f. The fact that kindred statements are made on all sides by other authors may be accepted as an excuse for the existence of the one here made, but it does not blot out the fact that such method of treatment is a continual source of confusion to the student of electromagnetic phenomena. The book has been carefully prepared, and the information which it contains is of undoubted value.

ELECTRICAL TRADES DIRECTORY. Handbook for 1904. 23d Year. London: *The Electrician* Printing and Publishing Company. Two volumes. Price, 15 shillings, 6 pence.

The twenty-third annual edition of *"The Electrician* Electrical Trades Directory and Handbook," popularly known as the "Blue Book," contains in the two parts no less than 2,000 pages. As in previous years, the work is issued in two volumes, a larger volume comprising the directory proper and a smaller volume devoted to biographical sketches of electrical engineers and to obituary notices. A pocket in the back contains five large sheet tables giving an account of the engineering and electrical equipment of all the central station, street railway and electric power plants of Great Britain, and of the same class of plants in the colonies. Among new matter are the government special rules recently adopted, relating to electricity in coal mining plants, and a digest of the agreement between the government and the National Telephone Company relating to the purchase by the State of the plant and the business of the company in 1911. There is a complete record of wireless telegraphic progress in 1904, including the reports of the United States Government boards on this subject. A summary is given of parliamentary action during the year with respect to legislation affecting electrical industry. A valuable feature is the section giving a digest of the British law of electric lighting, power, tractions and telephones. In fact, the first part of the larger volume contains a collection of digests, statistics, accounts of electrical progress, technical tables, etc., which is simply invaluable to those connected with the British electrical industry, and in great part of interest for reference to American electrical people.

BUSINESS SHORT CUTS. Compiled by the Board of Experts of *The Book-Keeper and Business Man's Magazine.* Detroit: The *Book-Keeper* Publishing Co., Ltd. 157 pages, illustrated. Price, $1.00.

This book is a compilation of many short articles giving directions as to how both time and labor may be saved in the handling of business details. It contains suggestions which will be found very helpful in accounting, book-keeping, card-indexing, advertising, correspondence and management. The range of subjects covered is a wide one, as may be inferred from the following partial list of the titles of articles: Rules for Locating Errors in Trial Balances; Labor-saving Method of Recording Bank Deposits and Check Withdrawals; An Up-to-date Cash Book; Special Form of Customers' Ledger; Figuring Percentages; Expense Adjustments; Efficient Method of Keeping Record of Office Supplies; Perpetual Inventories; Time-savers for the Office Man; A Safeguard for the Correspondence Files; On Handling Orders; A Quick Collection System; Efficient Method of Paying Employees in Large Factories; Short Cuts for Users of Printing; Keying Advertisements; To Save Postage, etc. Other articles tell how to detect clerical errors, compute interest and in many ways aim to lessen the labor incident to office work. Most of the articles are illustrated by diagrams of forms; indeed, these illustrations constitute a very important feature of the book.

Brevity is the underlying feature of the work and all the facts are stated in as few words as possible—to save the business man's time. It is essentially a business man's book, and the author makes no claims as to style or perfection in the art of book-making. Were he to do so, there would be ground for criticism, as the book is somewhat deficient in these respects. These lapses, however, do not in any degree impair the inherent value of the information contained in the work, as they are largely of a mechanical nature, arising, evidently, from hurried "make-up" and neglected proof-reading.

LIGHT ENERGY. By Margaret A. Cleaves, M.D. New York: Rebman Company. 827 pages, 55 illustrations. Price, $5.00.

This volume is intended as a text-book on radiation and its physiological effects, for the medical profession. The radiation considered covers visible light, ultra-red and ultra-violet light, electric waves generally, radioactivity, cathode rays, Röntgen rays and N-rays. The first two chapters are devoted to the physics of radiation. The rest of the book considers the biological, physiological therapeutic and pathological effects of radiation. The radiotherapeutic applications described may be classified as sun baths, arc light baths, incandescent light baths, ultra-violet light applications, X-ray applications, radium applications. Numerous references are made to the literature of the subject, and the clinical observations quoted are very full and complete. The work cannot fail to recommend itself to physicians interested in radiotherapy, such as practiced by Finsen, Bellini and others. The author is a well-known specialist in this branch of medicine.

RADIOACTIVITY. An Elementary Treatise from the Standpoint of the Disintegration Theory. By Fredk. Soddy, M.A. New York: The D. Van Nostrand Company. 214 pages, 40 illustrations. Price, $3.00.

Röntgen's discovery of X-rays ten years ago opened up a new field of inquiry in the domain of molecular physics. The nature of the new agent led to a general and animated discussion in which doughty and renowned champions met in academic conflict with the final, definite result that the X-ray must be considered a phenomenon of the ether rather than a swift-moving materal emission.

At the same time Crookes's contention valiantly carried out through a quarter of a century was also admitted that the cathode rays are not a phenomenon of the ether, but consist of a flight of material particles electrified by contact with the negative electrode of the "vacuum" tube. Following this came the startling announcement by J. J. Thomson that these flying particles are smaller than the atom, being indeed about the one-thousandth part of the mass of the hydrogen atom.

These were physical revelations of capital importance, but there were others of great import and far-reaching consequences to be heard of from the laboratories of Paris. Becquerel announced in 1896 the radioactivity of uranium, and the Curies subsequently discovered the most powerful of all these energy-giving bodies, viz.: radium. This brought about a general awakening and a new era in physical science. Foremost among the pioneers of the new physics stands Rutherford, who devoted to those delicate experiments his fine talents and splendid opportunities; and next to him comes his pupil and co-worker, Prof. Soddy, the author of the present volume. In the very preface we are given the assurance that "Radioactivity has passed from the position of a descriptive to that of an independent philosophical science, based upon principles, only the germ of which is to be found in physics and chemistry as they were understood *before* its coming." This has a genuine revolutionary ring in it; but is it really the pæan of victory of the new order over the old way of looking at the laws and workings of nature? We know that we must be progressive, but we cannot help thinking for the nonce of the old saying, *festine lente*. Eminent men have given us theories before which are now consigned to the limbo of oblivion. Ptolemy's deferents and epicycles are too old for reference here; but the vortices of Descartes and the emission theory of Newton are not; nor is the action-at-a-distance doctrine of the great mathematicians of the eighteenth century. These and a score of others put up a *caveat* and warn us to be judiciously slow not in accepting well-ascertained facts, but in accepting proffered explanations of them and generalizations drawn from them.

We notice that the book before us is written from the standpoint of the "disintegration" theory. As the new phenomena are but a decade old, does it not seem somewhat hazardous to speak of a "disintegration *theory*"? Would it not be more appropriate in the uncertainty which surrounds some data and the debatable character of others to call it "a working hypothesis"? Taken altogether, the facts, phenomena and data said to be observed, noted and collated seem, as yet, insufficient to warrant the claims put forth in favor of the astounding self-destruction tendencies of the Daltonian unit of elementary matter. Time may cool the enthusiasm of early workers and seriously modify the views now entertained by them with regard to the nature and changeability of the chemical atom. Their present transmutational results are perhaps better qualified as provisional than final.

The reader, who is accustomed to think of nature according to received principles, will be more than surprised to find the law of the conservation of mass called in question on page 180 and the accuracy of the second law of thermodynamics challenged on page 187. If these must go, then the "older" physics must be very effête indeed. Here are a few expressions that startle by their very novelty: "The internal movements of the atom must be highly irregular and cannot follow a definite sequence if the law of radioactive change is to hold" (page 179); "The main phenomenon of radioactivity has been shown to consist in the successive expulsion of positively charged particles from an originally neutral atom. The deduction, therefore, is that the atomic residue after each expulsion should be left negatively charged. In the cases which have been most completely examined, it is found to be left *positively* charged" (page 181). Should not this one cardinal fact make the votaries of atomic disintegration somewhat cautious in urging their theory; and should it not make us also cautious in receiving it? Yes, and all the more so when we are told on page 180 that "Atomic disintegration is of such a completely novel character, and is so far removed from all ordinary atomic and molecular phenomena, that none of the fundamental laws which regulate the latter necessarily apply, by analogy, to the former."

Prof. Soddy appears to be thoroughly convinced that the new phenamena can be explained by assuming the breaking up of the atom and the consequent emission of radiation and emanation; and he certainly places before the reader a considerable array of arguments as well as the chief experimental data by which the results have been achieved. The book is a storehouse of information relating to recent discoveries, and the information is given in a simple, connected and suggestive way that must commend the book to all students of contemporary science. Whatever the views one may hold regarding the structure of the atom and its internal energy, this work on radioactivity cannot be read without great profit. If it is "an elementary treatise," as the author modestly calls it, it is certainly a standard one.

The Arnold Company.

The Arnold Electric Power Station Company, feeling that its corporate name had become somewhat misleading, due to the expansion of its business to include much more than merely power station work, to say nothing of the fact that it is a rather cumbersome title for use in every-day business, has recently decided upon a change of name. The new name selected is The Arnold Company, by which name, as a matter of fact, it has been familiarly known for sometime past. The need for a descriptive title for this company disappeared many years ago as the work of the company and the personnel of its officers have been so familiar in the electric railway and lighting field that the name, The Arnold Company, fully serves every purpose. As said before, the scope of this company's work has for a long time included much more than simply the designing and construction of electric power stations. It includes all kinds of electric railway power and lighting, engineering and construction. The work for which this company is prepared to undertake the consulting engineering, and, if desired, the construction includes electric power stations, complete interurban railways, electrification of steam roads, shops and shop equipment, hydro-electric and transmission plants, investigation and reports, tests and inspection of electric properties, operating of electric properties and the modernizing of industrial plants. To be prepared to do this the company maintains a full construction organization with competent engineers in all branches, electrical, civil and mechanical.

The president of the company, Mr. Bion J. Arnold, started the Arnold Electric Power Station Company in 1896, the original work of the company being, as its name implied, the construction of electric power plants. Later, however, it took up much of the consulting work formerly done under Mr. Arnold's name, and it now takes care of all such consulting work except a few of the larger undertakings which have retained Mr. Arnold's personal services as consulting engineer, such for example as the New York Central electric terminal work in New York, and the work for the local transportation committee of the Chicago City Council, Chicago.

As was natural, the growth of The Arnold Company's business was in the direction in which Mr. Arnold was a specialist originally.

A list of the important work done by The Arnold Company shows electric railways and the shop equipment of steam railroads to hold the most prominent place, although a number of other important electric light and power plants have been engineered and constructed by this company. Mr. Arnold's experience previous to entering the field of electrical engineering was as mechanical engineer of an important steam railroad, which experience, together with his electrical engineering knowledge acquired later, put the services of The Arnold Company at once in demand for steam railway shop equipment.

The active engineering management of the company since its formation has been largely in the hands of George A. Damon, who was Mr. Arnold's assistant for a short time before the company was formed, and who has shown himself thoroughly capable of managing the various affairs of the growing business. Few young men in Chicago electrical engineering circles are as popular or looked upon as having brighter prospects in the profession than Mr. Damon. He is one who has always taken a keen interest in the future of those who are just entering the electrical engineering profession, and many a useful hint has been given by him to graduates of technical schools beginning their careers in Chicago.

The Arnold Company has justly earned a reputation of being progressive, but never at the expense of clients, innovations being adopted the minute their use seems justified, but not sooner. Some of the more important lectric railway work with which this company has been connected is in the building of the Grand Rapids, Holland & Lake Michigan Rapid Railway; Chicago & Milwaukee Electric Railroad, Chicago Electric Traction Company's line, Lansing, St. Johns & St. Louis Electric Railway; Kenosha Street Railway, and at the present time the Bloomington, Pontiac & Joliet Electric Railway, which is being equipped with single-phase, alternating-current, General Electric motors. The Lansing, St. Johns & St. Louis Electric Railway was the road upon which the first single-phase railway work in the United States was carried on in an experimental way by Mr. Bion J. Arnold.

The steam railroad shops for which this company has had charge of the light, heat, power, air and steam construction are the shops for the Chicago & Eastern Illinois, Chicago & Great Western, Denver & Rio Grande, New York Central & Hudson River, Oregon Short Line, Pere Marquette, St. Louis, Iron Mountain & Southern, Union Pacific and Wisconsin Central.

Electric power stations have been designed and built by The Arnold Company for the following: Imperial Lighting Company, St. Louis; Chicago Board of Trade; Albert Dickinson Company, Chicago and Minneapolis; W. B. Conkey Company, Chicago; Land Title & Trust Building, Philadelphia, and Otis Elevator Company, Chicago. An important water power development and a long-distance transmission plant are now being constructed by this company near Lowell, Kan. The plant will be about 3,000 kw capacity and will operate a 33,000-volt transmission line to the lead and zinc mines in the vicinity of Joplin, Mo.

This company was one of the first among consulting engineers to recognize the value of high-tension transmission for long electric railways with steam generating plants, and as early as 1897 took a contract for the equipment of the Chicago & Milwaukee Electric Railroad, with high-tension transmission to rotary converter substations.

The engineering officers of the company in the persons of President Bion J. Arnold and Managing Engineer George A. Damon, have already been spoken of. The matters of business detail are looked after by Vice-President W. L. Arnold and Secretary and Treasurer Ralph G. Arnold.

Quick Deliveries to Mexico from the Schenectady Works.

In order to enable the Mexican Light & Power Company to effect temporary repairs to its generating station in the City of Mexico, which was recently partially destroyed by fire, two express shipments were made from Schenectady on February 8 and 11, which were remarkable both for their size and prompt dispatch.

Telegraphic advices were received by the foreign department on Monday, February 6, stating that a large quantity of switchboard material would be required to enable the plant to resume operation, although at the time the full extent of the damage was not known. As a result of further telegrams and consultations by telephone with the New York representatives of the customer, details of the order were settled Tuesday morning, and on Wednesday, February 8, the second day from the receipt of information of the trouble, an express shipment of 30,000 pounds of switchboard instruments, switches and supplies left the Schenectady factory for Mexico City.

The shipment constituted a complete switchboard equipment for a 4,000-kw power station, and to collect and dispatch the material in this short time taxed every resource of the commercial, engineering and transportation departments of the company. While most of the instruments and switches were available at Schenectady, it was necessary to obtain instrument transformers by express from Lynn, and four large rheostats for generators of German make had to be entirely built from data telegraphed from Mexico. In addition, a large quantity of wire and cable, which could not be supplied from the Schenectady stock, had to be borrowed from an installation which the General Electric Company was carrying out in New York City.

The transportation of the heavy reels of wire and cable through New York City for shipment to Schenectady was a task of great difficulty on account of the almost impassable condition of the streets following a severe snowstorm. In handling the shipment from Schenectady special arrangements were made with the railroad companies to obviate transhipments in passing from one system to another, and especially in crossing the Mexican frontier, and in addition a special messenger traveled with the car the entire distance to see that no delays occurred at junction points.

The shipment reached Mexico City on Tuesday, February 14, thus placing in the hands of the customer, within seven days from receipt of the first news of the disaster and from a factory over 3,700 miles away, a complete outfit of the new material necessary to restore the interrupted lighting and power service.

The fire also destroyed two engine-driven sets, imperatively demanding the immediate installation of two 500-kw Curtis steam turbine generators that were on order at the time, and one of which was due to arrive by freight in a few days. The second turbine had just been loaded on a freight car at the Schenectady factory, but the urgent need of the machine decided the customer to authorize its shipment by express.

Of this shipment the turbine proper, as boxed, weighed 27,000 pounds and occupied a space of 8 ft. high by 8 ft. wide by 9½ ft. long. The doors of the ordinary express car would not admit the entrance of a package of these dimensions, but a special car having large doors was secured and by stripping the boxing to a minimum the loading was effected. The generator and other parts brought the weight up to nearly 43,000 pounds, making one of the heaviest single express shipments ever made. The total weight of the entire shipments was 73,000 pounds, the express rate on which was over $8,200.

Controlling Panel.

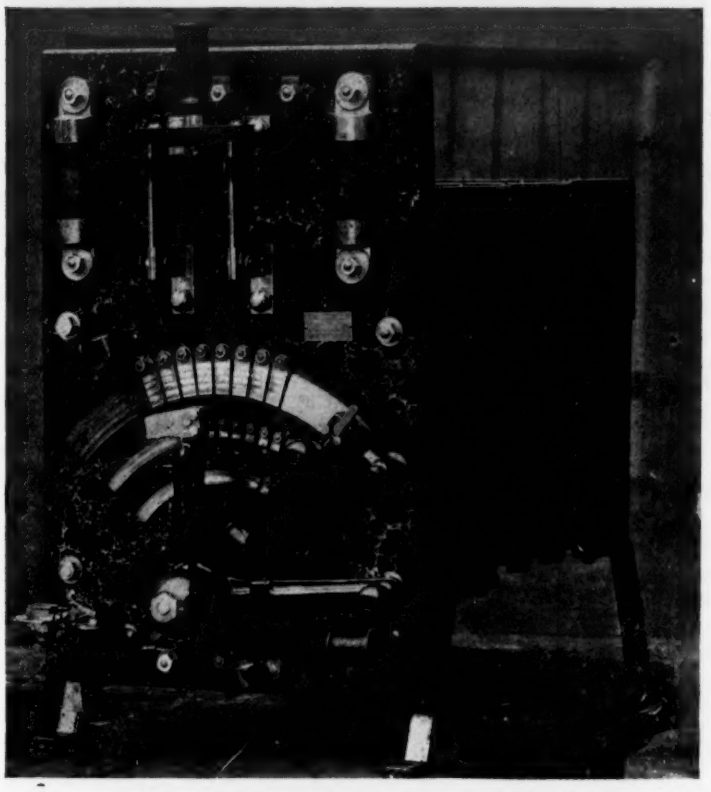
In Fig. 1 is shown a Ward Leonard 20-hp, 110-volt controlling panel having many unique features. There are four steps of starting resistance upon which the lever cannot be left, as there is a retractile spring which will bring the starting arm to the open circuit position if the operator releases the handle. Then there are four steps of armature controlling resistance upon which the lever can remain continuously. Then there are five steps of field resistance for speed variation by field control. The arm can be left upon any of these steps continuously.

The middle circle of contacts shown are used in order that there will not be (at any time) any of the starting resistance or the armature controlling resistance in series with the shunt field, and in order that there will always be maintained a closed circuit between the motor field and the motor armature, preventing destructive field discharge. The panel possesses also these very important features:

The controlling lever can be moved readily in either direction. It is to be noted that there are no gears or cog wheels to prevent the lever being moved freely.

The motor is protected against overloads at all times; that is, at the instant of making the circuit during the period of starting and

during the period of controlling as well as in the running position. The motor is protected while the operator has hold of the con-



CONTROLLING PANEL.

trolling lever, and the operator is also notified of "no voltage" while he has hold of the controlling lever due to the third arm shown at the right, which will hit the controlling arm a hammer blow upon "no voltage" and tend to carry it to the open circuit position. It will carry the controlling lever to the open circuit position if the operator does not have hold of the handle. If the operator should keep hold of the handle, then the overload circuit-breaker will open when the circuit is remade.

To prevent arcing upon the first live contact, there is provided an independent spring-operated, renewable, circuit-closing switch, which opens the circuit with a quick break, supplemented by a magnetic blow-out.

The stationary contacts are in the form of segments readily removable and renewable from the face of the slate. For each 30 amp. of the rated full load current, there is provided an independent self-aligning, renewable contact shoe upon the resistance controlling arm.

The resistance is made up of Ward Leonard enameled resistance units. The resistance wire is, therefore, entirely enclosed while the resistance units are well ventilated and readily renewable. The overload circuit-breaker is equipped with an auxiliary quick-break and magnetic blow-out.

Loew Feed-Water Heater and Oil Separator.

The Loew combination open feed-water heater and oil separator, made by the Loew Supply & Manufacturing Company, Cleveland, Ohio, combines the functions of thoroughly purifying the exhaust steam and removing all the grease and oil, while using every available heat unit for heating the boiler feed water. In addition, it filters the boiler feed water and removes any precipitate which it may contain. The feed water is controlled by a specially designed balanced float valve built to operate against a maximum pressure of 50 pounds. The materials in the heater are cast iron, copper and brass, which offer the greatest resistance to corrosion and acids. The clean-outs are made particularly ample for easy and quick accessibility.

Fig. 1 illustrates the open type of heater and separator. The steam first goes through the oil separator. After purification it passes up a channel on the side of the separator, indicated by the arrows, and enters the open heater; here part of the steam strikes the cold water, and part of it enters the tubes or gutters, where it is immediately condensed, and passes down with the heated water to the filter bed. The steam which enters the tubes or gutters, after accomplishing its purpose of heating the feed water,

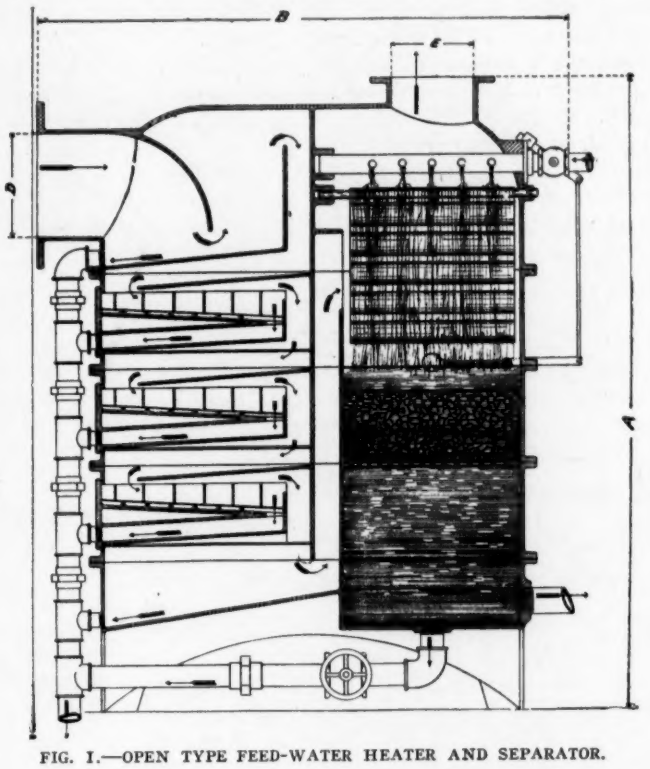


FIG. 1.—OPEN TYPE FEED-WATER HEATER AND SEPARATOR.

passes out of the steam outlet, without causing any back pressure. This dry steam can be used for any desired purpose about the plant. The inlet of the water is controlled by a float and balance valves shown in the sketch. After the water is heated by the exhaust

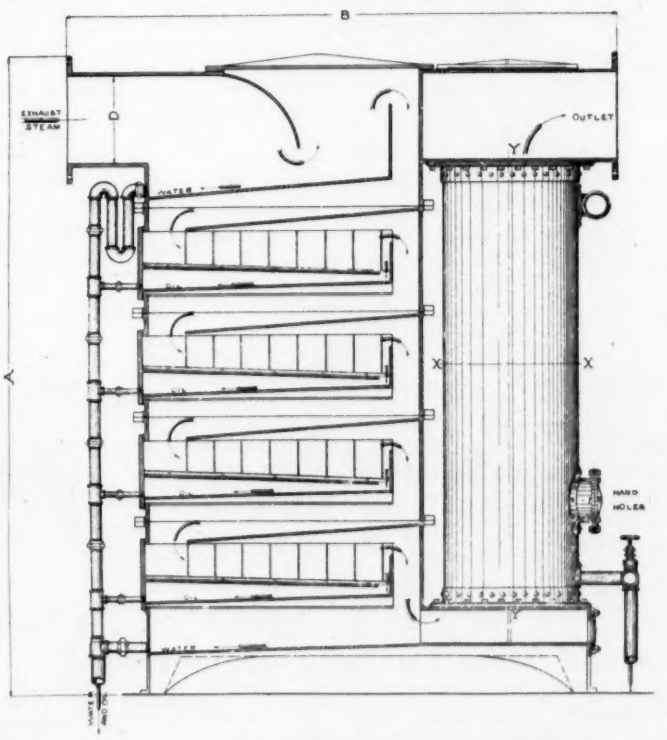


FIG. 2.—COMBINED SEPARATOR AND HEATER.

steam it passes slowly through the large filter bed into the storage chamber. From there it is pumped into the boiler.

The vertical straight tube type (Fig. 2) has brass, seamless-drawn, straight tubes, in a vertical position in the rear of the grease and oil separator. The exhaust steam passes out of the separator into the heater and travels the full length of the heater three times before it escapes. The water inlet is at the same end as the steam outlet. The water travels three times the length of the heater and enters the

boiler feed pipe where the steam enters, thereby causing a counter current and bringing the water up as nearly as possible to the temperature of the steam. The tubes can be reached at any time without taking the heater out of its permanent position. The exhaust steam when condensed can be used from this heater as it can in an open heater, as the steam is purified before it enters the tubes, and there is provision made to catch the resulting water.

In the cast-iron type (Fig. 3) the guide plates shown act as heating surfaces, and by connecting them all together a large heating surface is obtained, with a large filter bed and water storage capacity on top. The steam enters the top of this separator and gives up its heat as it passes down to the bottom. The water is fed in the bottom and out of the top, thereby extracting the maximum amount of heat and bringing the water as near as possible to the temperature of the

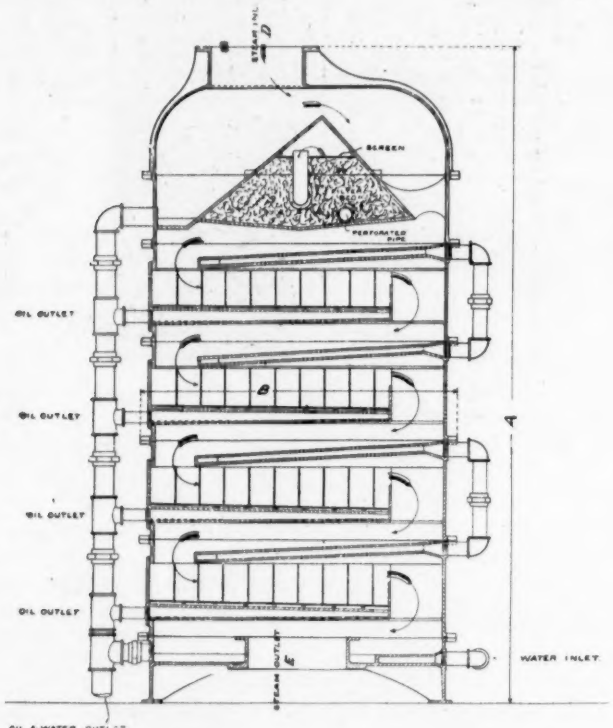


FIG. 3.—OIL SEPARATOR AND HEATER.

entering steam. The construction is such as to bring thin sheets of water in contact with the heating surface, thus quickly heating the water to the highest temperature, and precipitating all possible impurities; these are taken up in the filter bed, thereby furnishing pure hot water for boiler feed. The heater has mud blow-offs and ample clean-outs. As in the other types, prominent features are counter current and velocity.

Electric Fire Pumps in a Large Retail Store.

A general feeling that steam apparatus can be relied on with more certainty than can electrical machinery has no doubt been effective in delaying the installation of electrically-driven fire pumps. The economy and convenience of electricity over steam for driving these pumps has long been recognized, and it has simply remained for the electrical engineer to devise apparatus and central station supply systems that would insure reliability. Reliability has been obtained, however, in connection with three pumps recently installed for the sprinkler system of Marshall Field & Co.'s stores at Chicago.

The installation in the retail store occupies a pump vault bricked off from the surrounding portion of the basement. It consists of two independent units, each composed of a Laidlaw-Dunn-Gordon duplex pump geared to a General Electric motor. Each motor is controlled by a Cutler-Hammer controller of the multiple solenoid type, and is also provided with a separate manual controller.

The pumps are floated on a sprinkler system supplying about 16,000 sprinkler heads. A balancing tank of 1,500 gallons capacity is installed in connection with the pumps, to eliminate fluctuations of the starting device and provide a continuous discharge to the system. In designing and installing these electrical pumps one of the chief ideas was to afford them protection from water in case the basement should become flooded. The leads are carried to the controllers inside of a fire wall. The controllers themselves are enclosed in a moisture-proof steel case. As this method of installing restricts ventilation, it was necessary to place the resistances outside the controller proper. The grids of these are embedded in sand and are encased in cast-iron boxes. The leads between the controller and the resistances are carried in iron pipe conduit, as are also those leading to the motor.

Each motor is a 125-hp machine of special design, being constructed to specifications furnished by the engineering department of Marshall Field & Co. They are compound-wound and run at 165 r.p.m., and are so enclosed that water cannot enter when they are completely submerged. To afford proper ventilation, a fan is carried on the armature shaft, and this, when the motor is operating, forces air through the armature and fields. The discharge and suction for the fan are carried above the motor so that entrance of water through them is prevented until the motor is submerged to a point 8 ft. above the floor line. The allowable temperature rise in the motors after a 10-hours' run is 45° C. and the same rise is allowed in the solenoids of the automatic starters.

The pumps have cylinders 8¾ by 12 in. They are geared direct to the motors by means of spur gears with 10-in. face, reducing the speed of the pumps to 76 r.p.m. When working against a head of 175 pounds, each pump will deliver 850 gallons of water per minute. The automatic starting devices are so set that one of the pumps is started by a fall of from 10 to 15 pounds pressure in the sprinkler system. Should the first pump not be able to maintain the required head, the second one is thrown in operation by a further reduction of pressure.

Since installation, it has been found that one of the pumps is required to operate for a period of 10 to 15 seconds at intervals of about 24 hours to supply the leakage in the system. The current required to maintain the system is, therefore, very small.

Before the installation of the electric pumps, it was necessary to maintain high-pressure steam in two 100-hp boilers for operating the steam fire pumps should occasion arise. As the company obtains all its electric power from the central station, there is now no occasion to carry high-pressure steam. The economy resulting from the use of the electrically-driven pumps is, therefore, considerable.

All the details of the system have been worked out to meet the rules of the National Board of Fire Underwriters, and the installation has been approved by them. The personal efforts of the late Charles M. Wilkes, of D. H. Burnham & Co., and Mr. Arthur Hauxhurst, manager of Marshall Field & Co.'s insurance department, were largely responsible for the installation of the system in its present form. Realizing the advantages to be gained by, and the economy resulting from, the use of electric fire pumps, these gentlemen spent much time in devising an installation that would have the approval of the underwriters.

Mr. Frederick J. Pearson, electrical engineer for Marshall Field & Co., to whom we are indebted for this information, and who was in immediate charge of the installation of the pumps, states that, during their two months of service, no trouble whatever has been experienced in their operation.

Fire at Works of Burke Electric Company

The Burke Electric Company, lessee of the Keystone Electric Company, has just suffered loss and damage from fire in one of the wings of its works at Erie, Pa. A fire starting in the blacksmith shop spread very rapidly so that several departments housed in that particular wing were burned. The finished storeroom, containing principally Keystone machines, the forge room, punching department and stock room were practically consumed. The building will need to be entirely rebuilt. Fortunately, none of the finished Burke type of machines were lost, so that little or no delays will occur in the prompt shipment of current contracts.

Production will not be interfered with, as no dies or important tools were destroyed. The loss is fully covered by insurance and the Burke Electric Company will proceed immediately to rebuild the wing. The success which has followed the new designs of the company in both constant and variable-speed, direct-current motors and medium and slow-speed generators will probably necessitate working double-shift before the new building can be erected. Plans for a new wing and fixtures are now being hastened.

8000-hp Frequency Changer.

In our issue of March 11 appeared a short account of the great Bullock frequency changer made for the Shawinigan Water & Power Company, accompanied by an illustration of the machine. We are now enabled to give further information concerning this unique machine and its use.

The current is generated at Shawinigan Falls at 2,200 volts, 30 cycles, and transmitted to Montreal, a distance of 84 miles, over aluminum cables, the voltage being stepped up to 50,000. As the contract of the Shawinigan Company called for delivery of power in Montreal at 60 cycles and as it was found more convenient to transmit it at 30 cycles, it was decided to change the frequency at Montreal by synchronous motor-generator sets.

For this purpose the Shawinigan Company has erected a large terminal station at Montreal in which at present are installed five 1,200-hp frequency changers, one 8,000-hp frequency changer and two 900-kw, three-phase transformers. In addition to this apparatus there are also two 800-kw rotary converters which supply direct current to the street railway company. All these machines, including the starting apparatus, were built and installed by the Bullock Electric Manufacturing Company.

The 8,000-hp synchronous motor-generator set consists of a 5,750-kw alternating-current generator, an 8,000-hp synchronous motor and a direct-connected induction motor for starting purposes, all mounted on the same base. The motor is capable of developing a maximum starting torque equivalent to 2,500 hp. This set is not only the largest frequency changer ever built, but it is composed of the largest alternating-current generator in operation at the present time and the largest electric motor ever built. The total weight of this set is almost 500,000 pounds.

The armature yoke of the generator is made of cast iron, cast in halves, which are held in proper alignment by dowel pins and square splines, and securely bolted together. This casting is so cored as to allow the egress of an abundance of air for ventilation and still it is strong enough to form a rigid support for the armature. The yoke is built up of steel laminations .014 in. thick which are punched simultaneously with the slots from specially annealed sheet steel. They are annealed after the punching in specially constructed furnaces and then japanned to prevent eddy currents. As a further prevention against the formation of eddy currents, tissue paper is placed between the punchings at intervals of ⅛ in. Throughout the steel core brass castings are spaced at frequent intervals, which provide for ample ventilation. The coils are firmly supported by a wooden block bolted to the stator yoke shields on each side, thus rigidly holding the coils in case of heavy short-circuits. They are held in place in the slots by seasoned hardwood wedges. The total weight of the stator is 80,708 pounds.

The construction of the rotor is one of extreme strength. Upon the spider, which is of cast steel, are built up the steel laminations 1/16 in. thick. At suitable intervals spacing blocks 2 in. wide are inserted for the purpose of thorough ventilation. Dove-tailed slots are stamped in the rim of these punchings for the reception of the poles, which are held in place by wedge-shaped steel keys. The poles, of which there are twenty-four, are also built up of soft sheet steel, held together by phosphor-bronze end plates, securely riveted. Each pole weighs 1,130 pounds and the complete rotor weighs 78,455 pounds.

The mechanical construction of the synchronous motor is quite similar to that of the generator, there being, however, only twelve poles, each weighing 2,200 pounds. The complete stator weighs 93,250 pounds, and the rotor complete weighs 80,595 pounds.

These machines are rigidly connected together by a coupling forged with two flanges, the flanges at either end of the shaft being securely bolted to the spiders of each of the above machines. The rotor of the induction motor is mounted on the extension of the synchronous motor shaft. The weight of the metal required for babbitting the three bushings was over 10,000 pounds.

The base is cast into four sections, viz.: the two end sections for the main motor and generator, the middle section for the third bearing and a section for the induction motor. These separate parts are held in proper alignment by square keys and securely held together by shrink rings and bolts. The total weight of the base is 56,080 pounds.

This set was tested under full load conditions in the shops of the Bullock Company by the method originated by Mr. B. A. Behrend, chief engineer of the company. Although this method has been described in these pages, a brief description of the principles involved may be of interest.

In testing the generator, having twenty-four poles, the machine was connected so that twelve poles were in opposition to the other twelve poles. Half of these coils would then be acting as a generator and the other half a motor. The armature current would tend to magnetize the poles of the motor half and demagnetize the poles of the generator half, which would subject the machine to violent vibrations. In order to obtain magnetic balance each half is excited differently by placing a rheostat in series with each section and regulating the current. The C^2R loss is also accurately obtained in this manner as full load current is made to circulate through the armature coils and also full load current is carried by half the number of poles.

A Simple Wire Connector.

J. S. Tucker, of Chicago, has invented a wire connector for splicing line wires under tension, which is extremely simple both in its construction and application to the line. The connector is

WIRE CONNECTOR.

very much like a turnbuckle in form. The acompanying engraving shows the connector in one of its earliest forms. Improved designs giving better distribution of metal, however, are now being worked out. The holes in the ends of the connector are made oblong so that two wires can lie side by side in a hole. To apply the conductor the wires are simply passed in through the hole, bent double and drawn back tight, as shown in the engraving when a wedging effect takes place. The joint can then be soldered if desired.

New Type of Electric Fan.

A novel type of electric fan is being brought out by the Essex Electrical Company, of Newark, N. J. This consists of a ceiling fan

CEILING FANS.

combining the ordinary wooden sweep blades with individual fan motors built on the principle of the desk fan. The revolution of the small fan blades causes the fixture on which they are mounted to revolve, which fixture also carries the large blades, as shown in the illustration. The fan motors may be operated either at 1,300 r.p.m. or 1,800 r.p.m., and the fixture on which they are mounted revolves at from 12 to 14 times per minute.

A cup-shaped piece of metal supporting the wooden fan blades

is connected to the fixture containing the fan motors by a 9 to 1 gear. It is claimed that this fan uses 25 per cent. less current than the ordinary ceiling fan, while at the same time giving the effect of the ordinary ceiling motor and the added value of fan motors revolving in a circle and diffusing the air perfectly. Another point is that if desired the fixture itself may be stopped in its revolutions so that the fan motors may direct their air current as desired; moreover, these motors may be set at any angle.

The fans are made with or without electrolier attachment and are in two styles, one having the wooden fan blades set below the fan motors and the other with the blades above the motors. The two styles are shown in the respective illustration.

Stand Pipe Rheostats.

Queen & Company, of Philadephia, Pa., have designed recently a series of rheostats consisting of a continuous length of wire wound spirally on an iron stand pipe, about 6 inches in diameter, of a length depending on the total resistance and the current carrying capacity required. The wire is insulated from the iron pipe to withstand an alternating potential of 1,000 volts. The pipe is closed at the bottom, and by means of a smaller pipe, on either side of the base, a stream of water can be introduced for cooling purposes. If the rheostats are not used at their maximum capacity, water is not necessary. When only used at their maximum capacity for a few minutes at a time, the pipe filled with water, alone, is sufficient. Running water is recommended only when the rheostat will have hard continuous service at its maximum rated capacity.

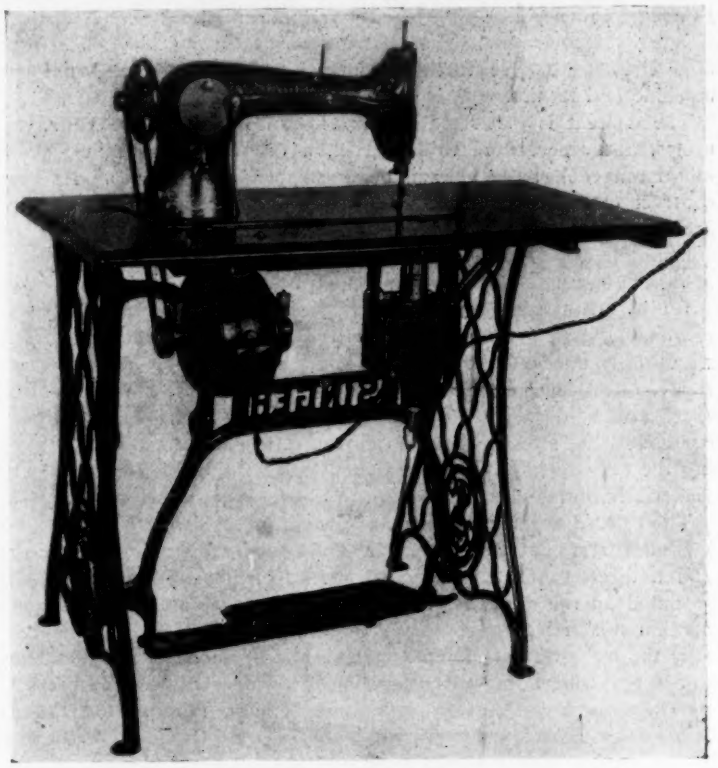
STAND PIPE RHEOSTAT.

The stand pipe is mounted on a hardwood base, provided with castors, so as to be easily moved about the laboratory. Mounted parallel to the upright pipe is an angle iron guide, which carries a slider, to which are attached phosphor-bronze springs. These in turn make contact against the wire on the pipe. All the parts are insulated except a rod in the center of the angle iron guides, which is connected with the phosphor-bronze springs by means of a split brass sleeve in the wooden handle. This gives a very smooth and even motion, and positive contact is made on every convolution of the wire, which allows adjustments of the current by almost infinitesimal steps.

These rheostats are highly useful for laboratory work in electrolysis, where it is necessary to secure fine graduations of both current and potential. To secure a potential regulation, the rheostat is supplied with two sliders, the terminals of the main conductor are connected with the main current source of supply, and the wires to the apparatus are connected to the two sliders. By putting the sliders together, the difference of potential is very small, whereas, by sliding them farther apart, it can be increased to any desired point.

Motors for Driving Sewing Machines.

One of the first applications of the electric motor was to the sewing machine, but it is a far cry from the crude types of twenty years ago to the sewing machine motor of to-day, an excellent example of which is illustrated in the accompanying cut. The motor is of the iron-clad type, the armature being wound with silk-insulated wire. It is fitted with bronze self-aligning bearings and lubricated by means of grease cups. The controller contains a regulating resistance and is provided with a dynamic brake attachment. This is so arranged that the shunt field coil retains its current until the armature comes to a full stop, when the field circuit is broken and the motor is entirely cut off from the current supply. The



MOTOR-DRIVEN SEWING MACHINE.

motor is built by the Diehl Manufacturing Company, Elizabethport, N. J., which makes a specialty of small multipolar motors adapted for special as well as general power purposes.

Haller Electric Signs and Flashers.

The Haller Machine Company, 127 Fulton Street, Chicago, is the manufacturer of the type of sign illustrated herewith, the points observed in construction being durability, safety, neatness of appearance and lightness of weight. The framework consists of a sheet steel background strengthened with wooden frames, which are heavily asphalted. A still more substantial construction is ob-

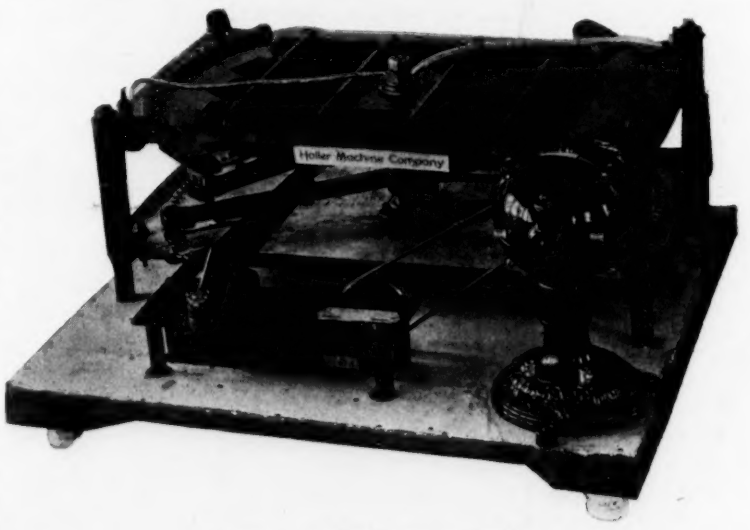


FIG. 1.—AUTOMATIC DIMMER.

tained by mounting the metal background upon an angle iron frame, but this method, of course, materially increases the weight.

Two styles of letters are employed by the company, namely, the raised letter and the grooved face letter. The raised letter, the style more commonly seen. is said to require a consumption of about

well as by night. To improve the appearance by day, the signs are decorated with attractive borders and scrolls, as shown in the illustrations, Figs. 2, 3 and 4.

One of the most important items to be considered by the manufacturer of electric signs is the economy in cost of operation, and

FIG. 2.—ELECTRIC SIGN.

many devices have been invented to effect and increase this economy without detracting from the general appearance of the sign. One of these is an automatic dimmer which has recently been placed on the market by the Haller Machine Company. The device is shown

FIG. 3.—ELECTRIC SIGN.

in Fig. 1, and consists of a motor, a reduction gear and a resistance, built on the principle of a theatre dimmer.

When this apparatus is in operation the lights in a sign are gradually extinguished, and after a few seconds of total darkness, they reappear and increase in candle power until the sign is again fully lighted. Then the same process is repeated over and over again.

FIG. 4.—ELECTRIC SIGN.

The effect is very striking. In a double-faced sign one side is lighted while the other one is dark. The saving in current amounts to 50 to 60 per cent., according to the speed of the motor and design of dimmer. The distinguishing feature from the ordinary flasher is that the current is never broken and sparking and consequent destruction of blades and jaws are done away with.

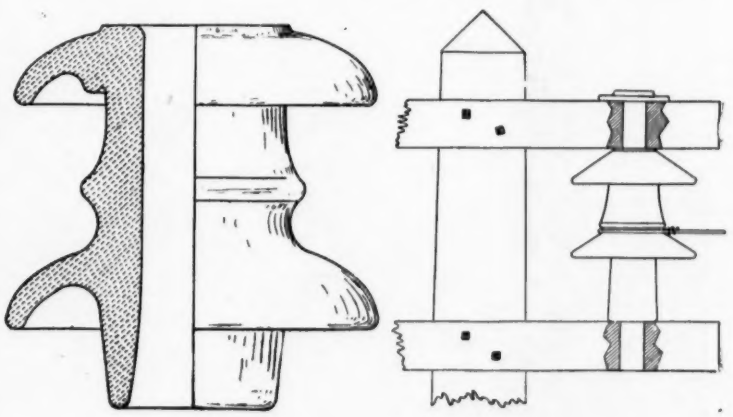
Mechanical Draft.

The first cost of mechanical draft, according to Mr. H. S. Knowlton in a recent article, is small in comparison with the capital invested in an equivalent chimney. Generally speaking, the cost of installing mechanical draft varies from about 20 to 40 per cent. of the expense of building a stack capable of doing the same work. Allowing 100 per cent. as the cost of the equivalent stack, a prominent authority on mechanical draft states that an induced draft plant with duplex fans is represented in first cost by 42 per cent., a single-fan induced draft plant by 26.7 per cent., and a one-fan forced draft plant by 18.7 per cent. Allowing interest at 5 per cent., depreciation and repairs at 4.5 per cent., and insurance and taxes at 1.5 per cent., the total fixed charges amount to about 11 per cent.

The cost of operation is, of course, the principal item of expense in a mechanical draft system. In one railway plant, equipped with 1,600 hp in boilers operated by a two-fan induced draft system, the annual cost of operation was $682, including repairs. Six boilers were supplied with artificial draft, the steam pressure was 125 pounds, and the cost of coal for the fan engine of 5 hp was about 2 per cent. of the total fuel bill. The first cost of the draft apparatus was $2,950, or $1.84 per hp of boilers served. Thus, the total cost of operation was 23.1 per cent. of the investment. The company allowed 4 per cent. depreciation, so that with interest at 5 per cent. and insurance and taxes at 1 per cent., the fixed charges were $295, and the total annual expense of the mechanical draft system was $977. The remainder of the plant was served by a chimney. Incidentally, the total rating of the plant was 3,000 kw; the first cost $90.60 per kw; the annual output at the direct-current switchboard 431,600 kw-hours, the coal consumption being 2.9 pounds per kw-hour, and the water consumption 28.07 pounds per unit of output. The cost of installing the mechanical draft apparatus was thus about 2 per cent. of the total plant investment.

Strain Insulators for High Tension Trolleys.

The development in high potential trolley work has necessitated and led to improvements in insulators used in that field, and the Locke Insulator Manufacturing Company has been giving special attention to the subject. It has recently introduced the strain insulator shown herewith 6 in. high and 5¾ in. in diameter, developed for pressures as high as 8,000 volts. The concern has also developed a smaller design of strain insulator for voltages of 5000 volts and under, which is found very useful in the construction of spans for trolley suspension. The Locke line of these devices includes now all sizes and endurances up to 35,000 volts, and the company is now at work on a new design that it expects to manufacture for voltages of 60,000 and upwards. In regard to this work, the Locke Company says: "As to mechanical strength, we have experimented con-



FIGS. 1 AND 2.—STRAIN INSULATORS.

siderably with these designs, and find that our larger types can be relied upon to stand a breakdown test of approximately 12,000 volts with the insulator supported by a pin passing through the middle, and the strain applied around the middle groove. We have in connection with these insulators, developed a method of using, whereby almost any strain up to several tons may be applied with entire safety."

Overhead Conveying System in Interborough Shops.

One of the most interesting features of the inspection shed and repair shop, recently completed for the New York Subway, at Seventh Avenue and 148th Street, is the overhead conveying system installed by the Northern Engineering Works, at Detroit. This consists of an electric traveling hoist and an overhead track which connects the different buildings. The space covered is practically an entire block, the blacksmith and paint shops at the north end being separated from the main building by an electrically operated transfer table. The track is a 15-in. I beam bolted to the under side of the roof truss. It runs the entire length of the north and south

bays of the inspection shops, crossing the middle bay at either end. Branch tracks, supported by steel trusses, extend over the transfer table and run the length of the blacksmith and paint shops. Curves, track switches and turntables enable the traveling hoist to reach the elevator in the storeroom, as well as other parts of the building, where there are special tools. The traveling electric hoist has a capacity of four tons. It has been of great service, during the fitting up of the shop, in installing the machine tools, rotary transformers, motors and other machinery. Since the shops have been in operation, the hoist has been in constant use, mounting motors on the car's trucks, replacing car wheels, taking armatures or any other parts of the cars to the machine tools for repair, eac. The motors on every subway car fitted up in this shop have been put in place by this machine. The convenience is great. No passage-ways have to be kept open, and no floor space is used; consequently, there are no delays in handling any of the machinery or in transferring materials from one building to another. Mr. J. Van Vleck and Mr. W. C. Phelps, of the Interborough Company, assisted by Mr. R. A. Byrns, of the New York office of the Northern Engineering Works, are responsible for the general design and the layout. The system was manufactured and installed by the Northern Engineering Works.

Coal Handling by Electric Motors

The Northwestern Fuel Company docks at West Superior, Wis., are probably equipped with the most modern coal-handling plant in the world. Fig. 1 shows the plant unloading the freighter *Augustus B. Wolvin.* The rapid and complex movements of the machinery that covers the very extensive docks are all effected by General Electric motors, while the entire plant was designed and manufactured by the Brown Hoisting Machinery Company, of Cleveland, O.

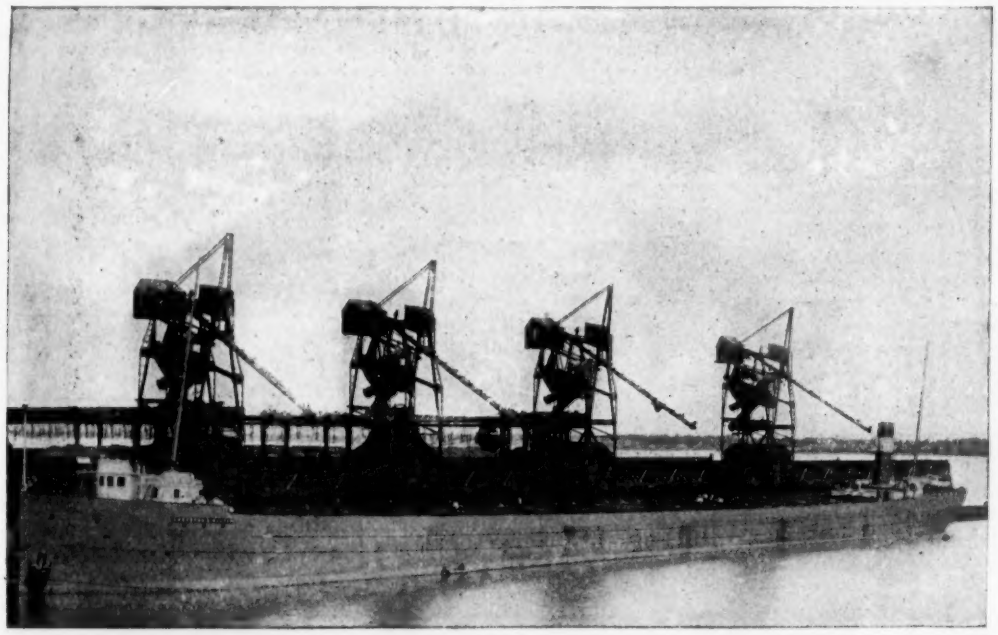


FIG. 1.—UNLOADING THE STEAMER "AUGUSTUS B. WOLVIN."

Fig. 2 serves to make clear the remarkable scope of this plant in facilitating the handling and storage of coal. The plant has a dock storage capacity of about 1,250,000 tons, and the company can handle during the season of navigation (five months of the year only) 600,000 tons. Running along one edge of the dock are four "fast plants," built up like immense towered gantry cranes. There are two standard gauge track systems parallel to the edge of the dock, comprising two tracks running along the side beneath the "fast plants," and two tracks on the other side. The dock is spanned by three traveling bridges covering the storage area between the two systems of tracks, and there is an elaborate system of transfer cars, trolleys, pockets and bins.

Four tower fast plants are used exclusively for unloading vessels. Each is equipped with a 185-hp motor for hoisting the 1½-ton grab bucket with which the plant is equipped, at the rate of 600 ft. per minute, and for giving the tower itself a traveling speed of 250 ft. per minute. Each tower plant is also equipped with a motor for racking the grab bucket at 1,200 ft. per minute, and with a 7½-hp motor for operating the gates of the 20-ton tower pocket.

Three bridges are used to facilitate the unloading and distributing of the coal. Each bridge is driven at the rate of 150 ft. per minute by a General Electric 57 motor geared to three of the four trucks of the bridge.

There are four stocking trolleys of the "man type," i. e., each carrying its own motor-operating man and equipped with a 7-ton bucket and operated at 1,200 to 1,500 ft. per minute by a motor. Three shovel trolleys of the man type are each equipped with a 4-ton shovel bucket. Two motors in series parallel operate to give the trolley a traveling speed of 1,200 to 1,500 ft. per minute and a hoisting speed of 200 ft. per minute.

Three transfer cars serve as flexible connecting links to the above machinery and are used exclusively to transfer the stocking trolleys and shovel trolleys from a fast plant to a bridge or from one bridge to another bridge, thus avoiding the relatively slow and expensive moving of the heavy fast plants and bridges, and facilitating a quick service over the wide area of the dock. The traveling speed of these cars is 600 ft. per minute, and they are each operated by one motor.

The following operations, an understanding of which will be aided by inspection of Fig. 2, may be effected by this machinery:

Coal is taken out of the boat by grab buckets and unloaded in the fast plant tower pocket. From the tower pocket it may be delivered, first, into the adjacent tower bin, from which the freight cars on tracks 3 and 4 are loaded; or second, into the bucket of the stocking trolley, the latter being carried adjacent to the tower pocket

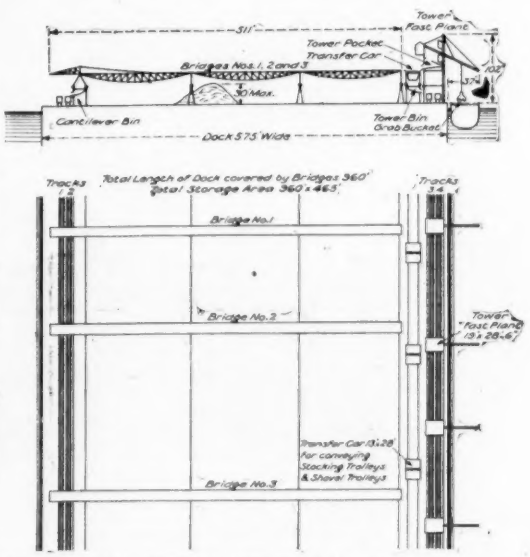


FIG. 2.—CROSS-SECTION AND PLAN OF COAL-HANDLING MACHINERY.

by means of the transfer car, which travels either along the top of the tower bins, unloading in the emptied pockets, or along the top of the tower bins, the stocking trolley leaving the transfer car by one of the bridges and dumping its load on a stock pile into the cantilever bins, or into freight cars on tracks 1 and 2.

In distributing or loading, coal is taken from the pile by shovel trolley and sent over the bridge, to be dumped on another stock pile; or dumped into a cantilever bin; or dumped into freight cars on tracks 1 or 2; or met by a transfer car which carries it to an empty tower bin, or to another bridge for dumping on the stock pile.

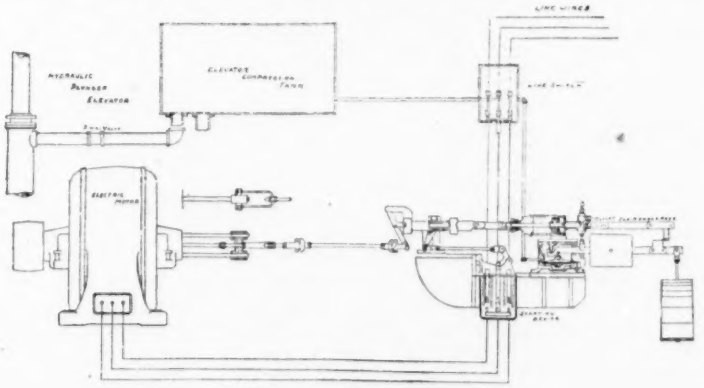
Unloading to stock piles or bins, transhipment to freight cars and redistribution are accomplished with the utmost flexibility in the operation of the various elements of the plant. The value of electric power as applied to this plant could not be overestimated. A steam or compressed air installation would give trouble from freezing in cold weather. There would be high maintenance charges all the year round and heavy losses from rope or other forms of mechanical transmission. Moreover, steam engines or compressed air motors would be too bulky to be considered. It may safely be affirmed that if steam or compressed air had to be relied on no such flexible and complete arrangement as the one above described, which is successfully operated by electric motors, would have been attempted.

Automatic Motor-Starter for Electrically Driven Pumps.

It is often convenient, for the purpose of saving power and for other considerations, to arrange electrically-driven pumps to be automatically started and stopped with the demand for water. There are many controllers on the market for accomplishing this in the case of direct-current motors, but the handling of alternating-current motors has not been given so much attention. The automatic starter described below, which has been especially designed for handling an induction motor of the type having variable resistance inside the rotor structure was recently installed in connection with an elevator equipment in one of the large business buildings in Holyoke, Mass.

The elevator is of the hydraulic type, in which the car is supported by a long plunger working in a cylinder to which water is admitted as desired from a closed tank. This tank is supplied with water by a 5 by 8 Deane vertical triplex single-acting power pump, designed for a maximum water pressure of 150 pounds, and means are provided for automatically stopping and starting the pump to maintain a constant pressure in the tank between certain fixed limits. The pump is connected to a 15-hp General Electric induction motor operated by three-phase, 60-cycle, alternating current at 550 volts. The generator supplying the current to the motor is of such small size that it was feared that the fluctuations from the frequent starting and stopping of the motor would seriously affect the regulation of the potential of the distributing system and the above type of motor was selected as being best adapted for these conditions. In operating this motor the resistance is thrown in before starting, so that, at starting, all the resisance is included in the armature circuit. As the motor increases its speed, the resistance is gradually cut out by a movement of the sliding rod or shifter. In stopping the motor the current is first cut out by means of an oil-break switch and then the resistance is thrown in ready for the next start. Since no sparking is produced at the contacts, the equipment should render consistent service for a very long time.

The accompanying illustration shows the automatic controller arranged in combination with the motor and pump. A water pipe connects the elevator pressure tank with a Mason automatic belt shifter, consisting of a diaphragm chamber and a cylinder in which



AUTOMATIC MOTOR-STARTER.

a piston moves. The pressure of the water beneath the diaphragm is balanced by a heavy weight and any variation of this pressure causes the diaphragm to move a pilot valve, admitting water to the cylinder for moving the piston. This belt-shifter is arranged in connection with a special device, so that when the pressure in the elevator tank falls below a certain point the upward movement of the piston in the cylinder will first close a switch admitting current to the motor and then throw the resistance rod to remove the resistance, gradually as the motor gains speed.

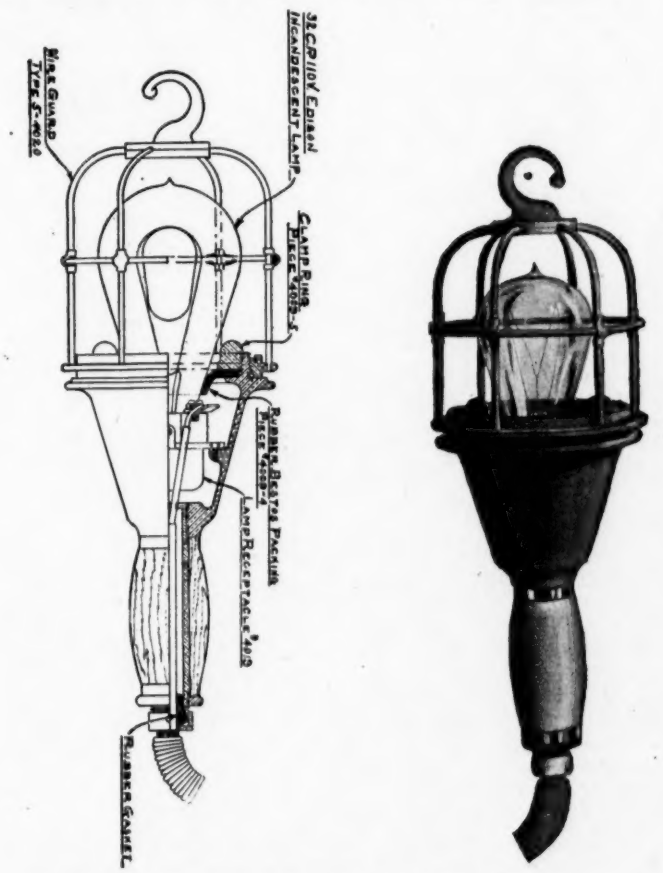
As soon as the pressure in the tank has been raised to the desired point, the controlling device operates first to open the switch to stop the motor, and then to throw in the resistance by pulling out the resisance rod or shifter. This is accomplished by mounting a set of cam pawls upon a slide connected with the piston of the shifter cylinder to form a ratchet which engages a cam lever connected with the switch break. The cams are so formed that the switch lever is always thrown before the resistance is shifted, no matter in which direction the piston moves, so that the initial rush of current to the motor will always be properly limited, and the motor will start and accelerate with a good torque, while the efficiency under running conditions is kept quite high.

The successful operation of this device in connection with this type of motor has solved a serious problem in elevator work where the current is used for both lighting and power service and the generator is of small size. The International Steam Pump Company, of 114 Liberty Street, New York, is prepared to supply this apparatus in connection with power pumps wherever the conditions render its use advisable.

Water-Tight Electric Light Fixtures.

The requirements of marine installations as to water-tight fixtures are necessarily very severe, and this is reflected in the Government specifications for this class of electrical work. To meet all the requirements, Garrett, Miller & Co., of Wilmington, Del., have designed the fixture shown in the accompanying illustrations, which has been installed on a large number of Government army dredges and steamers and United States coast survey vessels.

The guard is constructed of wrought brass and the shell is cast



FIGS. 1 AND 2.—WATER-TIGHT ELECTRIC LIGHT FIXTURES.

in brass composition or aluminum. In the case of both the guard and the shell the cross-section is ample to withstand the most severe conditions of service. The socket of the interior fitting is made of heavy glazed porcelain and is securely held in the shell by a winged ring having countersunk slots which engage two screws set in the bosses on the inside of the shell, thus facilitating removal and replacement. The connection terminals are brought well up to the mouth of the shell, thus permitting the fixture to be wired with the greatest ease.

The packing ring is punched from sheet packing. The nut is supplied with two diagonally projecting lips and has threads chased on its outer periphery to enter threads in the shell. This permits of a rapid renewal of the packing ring and the inspection of the interior of the fixture. By this means an absolutely self-adjusting water-tight joint is secured in an extremely simple manner. With this method of securing a water-tight joint, the use of supplemental globes or glass casings is rendered unnecessary and consequently the reduction of light is avoided which occurs when such supplemental casings are used.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Improvement is reported in all lines of trade, but warmer weather is needed to develop full spring activity. Mercantile payments are more prompt, which promotes greater confidence in the general situation. Railway earnings, which have been falling behind in comparison with last year, were 8.1 per cent. larger for the first week of March, and there is comparatively little complaint of freight congestion. Floods have done some damage on the Pacific Coast, but farming prospects there, as in most other sections, are decidedly favorable. Good progress is noted in conditions at pig-iron furnaces and steel mills. Aside from a few plants that are not in first-class condition, practically all the furnaces are in full operation, and a ready demand is found for all the pig iron produced. Contracts cover deliveries many months in advance, and a large sale is rumored. Prices are well maintained, and the leading interest is expected to make a general increase of 10 per cent. in wages on April 1. This is another evidence of confidence in the future. Finishing mills are crowded with business and four months' time is demanded for deliveries on new orders. Foreign orders for rails are a feature which throw doubt upon the talk of agreement between the world's producers as to spheres of influence. Railway material is being bought freely for domestic account. Coal has continued in good demand. Bituminous is active at good prices. The copper market was quite dull, and prices are practically unchanged, at 15¼ to 15⅜ for Lake; 15⅛ to 15¼ for electrolytic, and 14⅞ to 15 for casting stock. Export trade is still on the ebb, but imports break all records. The total shipments for February were the smallest reported for some years past. Imports, on the other hand, for the first time passed $100,000,000, and the small balance of trade in favor of February exports was reduced to the vanishing point. Heavy shipments of cotton previously and the increase in exports of manufactures helped the present year's total to make fairly good comparisons with a year ago, but the prospects favor a continued ebb until the new fiscal year begins. Bradstreet's reports 186 business failures during the week ending March 16, as compared with 190 the week previous and 193 the corresponding week of 1904.

OWENS RIVER POWER CONTRACTS.—Leon M. Hall, engineer for the Owens River Power & Water Company, has issued specifications for the electric generating plant, which is to be installed in connection with that company's project for transmitting power about 96 miles to Tonopah, Nev., via Goldfield. The specifications call for two 1,000-kw, three-phase, revolving field, 25-cycle generators, which are to be direct-connected to water wheels designed to operate with a head of 200 ft. of water at 400 r.p.m. There will be four 750-kw transformers at the power house, raising the voltage to 50,000 volts for transmission. The Tonopah sub-station will be equipped with four 400-kw transformers, and the one at Goldfield will have four 300-kw transformers. The transformers at the power house will be oil filled and water cooled, while those at sub-stations will be oil filled and self-cooling. Instead of a canal, 9,600 ft. of redwood wooden-stave pipe, 60 inches in diameter, will be required. As lighting will be a very small item, compared with power in the Nevada mining camp, the projectors of this company consider the use of 25-cycle generators much preferable to machines operating at a higher frequency. They are confident that their prospects are excellent for securing power contracts from the mining companies that are to erect reduction works, although they may not be the first to reach Tonopah with a transmission line. The main generating plant will be constructed without delay in the canyon of the Owens River in Inyo County, Cal., about 1½ miles below where Birchim Canyon intersects it. The transmission line will extend over into Round Valley to a point 1¼ miles north of Laws; thence to the mouth of Silver Canyon and on to Goldfield. Water rights are owned by the company at two feasible power sites on Owens River, the first one to be utilized being on the east side of that stream. If business warrants it, an additional transmission line will be built to reach other mining territory. Cedar poles will be used with 14-inch three-part earthenware insulators. Engineer Leon M. Hall has an office at Room 814, Kohl Building, San Francisco.

TRADE WITH EGYPT.—Consul-General Morgan, of Cairo, Egypt, in a recent report, deals trenchantly with American commercial methods in connection with the import trade of Egypt. He states that American imports are not holding their own in Egypt and that present indications point to a further falling off unless some radical change is made by those whose principal interest it is to develop the foreign trade, supply new markets and create demands. American manufacturers, he states, are not amenable to suggestions in their own interest made from Egypt, and this applies especially to the machinery trade. Unlike British manufacturers, the Americans refuse to guarantee their goods, contenting themselves by saying "Machines do the work we claim for them in this country," (the United States), and then proceed to put idiomatic expressions into their letters, which are, in many cases, beyond the linguistic attainments of the intending agent or purchaser. Suggestions as to finish of certain wearing parts are as regularly scouted as they are made, as are also suggestions to make machines more adaptable to the peculiar conditions of the country, etc. He cited one case where a merchant on a visit to the United States failed to induce manufacturers to introduce certain modifications in their agricultural machinery, and as a result gave an order to a British manufacturer, paying 30 per cent. more for his machines. The report also treats the matter of European agencies, and particularly that of credits. Those interested in the export business, whether with Egypt or other foreign countries, would probably find it to their advantage to get a copy of this report. It is "Daily Consular Report" No. 2,207, dated March 16, 1905, and a copy may be obtained from the Department of Commerce and Labor.

WESTINGHOUSE SALES.—Among recent contracts of the Westinghouse Company, which illustrate the diversity of its output, are the following: As an extension to its system the Louisville Railway Company will install two 750-kw, three-phase rotary converters, six 300-kw, air-blast transformers, with blower outfits, and two switchboards. The United Railways & Electric Company, of Baltimore, has contracted for three 1,000-kw rotaries and nine 350-kw air-blast transformers. These will operate on a 13,000-volt line, transforming to 330 volts. Enghteen rotary converters, with a total capacity of 27,000 kw, in 1,000 and 1,500-kw units, will be placed in substations of the New York Central Railway Company. Two 1,500-kw direct-current generators will be built for the Carnegie Steel Company to furnish power for two 1,500-hp, 250-volt motors. For the protection of this apparatus 10,000-ampere circuit-breakers will be mounted on the switchboard. These motors will be the largest ever built for this voltage. As representative of output in small apparatus may be mentioned an order from the Surpass Leather Company, Philadelphia, for eighteen induction motors, varying in size from ½ to 50 hp, to be used for driving machines. The State Company, of Columbia, S. C., has contracted for twelve direct-current motors, ranging in capacity from 1 to 20 hp, and Murdock, Kerr & Co., of Pittsburg, will receive the same number, having various outputs from 2 to 70 hp.

CANDY FACTORY PLANT.—Two Reynolds-Corliss non-condensing, horizontal tandem compound engines are to be installed in the new power plant of Henry Heide's candy factories, at Hudson and Vandam Streets, in New York City. The cylinders are to measure 18 and 28 inches, and the stroke will be 42 inches. The engines have been built by the Allis-Chalmers Company at its West Allis shops. Each is to be direct-connected to a 300-kw multipolar generator and will develop 465 hp running at 100 r. p. m. The steam and exhaust valves of both the high and low pressure cylinders will be operated by independent eccentrics, thus giving a cut-off range from zero to three-quarters stroke. The valves of the low-pressure cylinder are to be placed in the heads. The plant is designed to furnish light and power to both the old and new buildings. The factories are to be operated by electric power as soon as the plant is in running order.

SUSQUEHANNA ELECTRIC POWER COMPANY.—It is stated here that the newly organized Susquehanna Electric Power Company will establish an electric power plant at Conawingo Falls in the lower Susquehanna River during the coming spring. The company is capitalized at $12,000,000. It has secured hundreds of acres of land on both sides of the Susquehanna River, with a view of beginning operations as early as possible. A large reservoir will be built, which will serve to store water enough over night to assist the plant in day time. The reservoir will be several miles long. Capitalists from New York, Philadelphia and Baltimore are stated to be behind the project.

STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY reports having closed contracts for switchboards for the following places: Ames, Ia.; Liberty, Ill.; Daykins, Neb.; Higginsville, Mo.; Ashton, Ill.; Sheffield, Ill.; Walnut, Ill.; Lamoille, Ill., and Buffalogap, S. D.

BELL INSTRUMENT OUTPUT.—The gross instrument output of the American Telephone & Telegraph Company for the month of February broke the record, amounting to 134,301, as compared with 130,634 for January, the previous high record. The net output for February was less than for January, being 86,724 instruments. The February net output was, however, much larger than that of the average month. The net output for the first two months of 1905 was 179,658 instruments, or almost 4 per cent. of the entire number of instruments outstanding on December 31. At this rate of growth the expansion of the Bell system for 1905 will be equivalent to over 20 per cent. The increased output of instruments will be reflected in the direct net earnings of the American Telephone & Telegraph Company in the form of increased rental of instruments, says the *Wall Street Journal.* The amount received for rental of instruments in 1903 was $3,047,088. The increase in the number of instruments outstanding during 1904 was about 20 per cent., indicating a gain of about $600,000 in rental of instruments for that year. The total increase in net earnings of the company for 1904 was $1,350,897. Allowing for a gain of $600,000 in rental of instruments and of $200,000 in net earnings of long-distance lines, there is indicated a gain of only about $500,000 in dividends received from sub-companies during 1904. The increase in sub-company dividends for the previous year was nearly $1,800,000, indicating that the equity of the parent company in sub-company earnings was larger for 1904 than for 1903.

HONOLULU POWER TRANSMISSION.—The Kauai Electric & Power Company, controlled by the McBryde Sugar Company, has closed a contract with the Hawaiian Electric Company, which carries the Westinghouse agency in Honolulu, I. H., for generators, transformers, etc., for a water power electric transmission plant to be operated with water from the Wainiha River on the Island of Kauai. The water will be conducted mostly through rock tunnels for a distance of about five miles along the sides of Rock Canyon to a point where a working head of 550 ft. will be utilized. Power will be transmitted 35 miles to the McBryde plantation, at 33,000 volts, for the operation of a sugar mill, about 2,000 hp being required. The Hawaiian Electric Company will construct the entire electric system. The contracts call for two Westinghouse 1,200-kw, three-phase, 25-cycle, 2,200-volt generators, each of which will be direct-connected to a Pelton water wheel. It is said that the contract with the Pelton Water Wheel Company calls for two 2,500-hp impulse wheels. The step-up and step-down transformers will be in units of 500 kw each. A. Godley, manager of the Hawaiian Electric Company, is in San Francisco on business connected with the closing of contracts. The pressure pipe that conducts the water from the ditch to the wheels will be of steel 3½ ft. in diameter and 1,300 ft. in length. The power station of concrete with iron roof will be 40 by 80 ft.

TRUCKEE RIVER GENERAL ELECTRIC COMPANY.—The stockholders of the Truckee River General Electric Company, of which Mortimer Fleishhacker is president, have voted to increase the capital stock from $2,500,000 to $3,000,000. The increase was not made for the purpose of issuing bonds, the company having done all of its construction work with private capital. An additional power plant is in course of construction on the Truckee River, six miles below the plant, near Floriston, Cal., and will increase the earning capacity of the system, making the increased capitalization advisable. For some time past the Truckee River General Electric Company has been paying monthly dividends at the rate of $1.20 per year per share of a par value of $50. The new plant, which is now in course of construction, will have an initial installation of a 1,500-kw, three-phase generator, direct-connected to a water wheel. It will be completed in time to supply current for the mines of the Comstock Pumping Association, at Virginia City, Nev., under a new ten-year contract, which will take effect next October. The original plant now furnishes light and power for the Comstock mines, besides lighting Carson City and other towns in Nevada.

THE NEVADA POWER, MINING & MILLING COMPANY has closed contracts with the Pelton Water Wheel Company, of San Francisco, for two water wheels, each of which is to be direct-connected to a 750-kw, three-phase, 60-cycle National Electric generator for the new electric transmission from Bishop Creek, Cal., to Goldfield and Tonopah, Nev. The regulation will be effected by Sturgis governors. The working head of water is 1,024 feet. The Pelton Water Wheel Company also secured the contract for supplying 3,240 feet of lap-welded steel pipe, 24 inches in diameter, for conducting the power water from the penstock to the water wheels. This pipe, which will vary from ½ to ⅜ and ¼-inch in thickness, is to be manufactured in Germany and must stand a test of 650 pounds per square inch. The Stanley Electric Manufacturing Company was awarded the contract for four 500-kw oil filled water cooled transformers. The coast office of the company is at 402 Rialto Building, San Francisco. R. M. Jones is construction engineer and C. O. Poole consulting engineer.

GUANAJUATO POWER SYSTEM TO BE EXTENDED.—The Guanajuato Power & Electric Company, Limited, which operates a hydro-electric plant on the Douro River, Mexico, and transmits the electric energy to the Guanajuato mining district, about 100 miles distant, has decided to double the capacity of the installation. The existing equipment consists of two 1,125-hp Pelton water turbines, direct-connected to General Electric generators. The contracts for the additional machinery, etc., will be placed through the New York offices of the company, Hanover National Bank Building, Pine and Nassau Streets. Mr. Henry Hine, at one time manager of the Stanley Electric Manufacturing Company, Limited, is president of the Guanajuato Company. He is now in Colorado Springs, but is expected to be in New York next week. While here he stops at the Waldorf-Astoria.

THE BOURBON GOLD MINING & ELECTRIC POWER COMPANY, San Francisco, has closed a contract with the Westinghouse Electric & Manufacturing Company for two 750-kw, three-phase generators, transformers, etc., for a new electric transmission plant at a point about six miles east of Murphy's, on the Stanislaus River. Each generator will be direct-connected to a water wheel operating under a head of 240 ft. About 10,000 miners' inches of water have been acquired. The hydraulic development, including 2½ miles of ditch and flume, is under way and a penstock has been constructed. The Bourbon mines will take 200 hp and the remainder of the electric power will be transmitted to other mines within a radius of 20 miles. Mr. Walter N. Brunt, San Francisco, is president and W. K. Tulloch secretary-treasurer of the company.

NEW WESTINGHOUSE PLANTS.—The fine new marble Tiffany building, on Fifth Avenue, is to have a 400-hp lighting plant The equipment will consist of Westinghouse generators, one 125-kw, 120-volt, 250 r.p.m. machine; one 75-kw, 275 r.p.m.; also one of 50-kw capacity, to be direct-connected to Ames engines—single cylinder, high-speed type—of 200-hp, 120-hp and 80-hp capacity, respectively. The Botany Worsted Mills, at Passaic, N. J., have contracted for a 135-hp single high-speed engine of Ames Iron Works build, to be direct-connected to an alternating current Westinghouse generator of 250 revolutions a minute, 85-kw capacity.

LIGHTING PLANT FOR ECUADOR.—The export house of Parraga Brothers, 95 Pine Street, New York City, has placed a contract in this market for various equipment to be installed in a water power plant for the purpose of generating current to light the City of Quito, capital of Ecuador. The machinery will include a 400-hp Pelton water wheel, arranged for direct connection to a 250-kw General Electric generator. The equipment will operate under a head of 200 ft. Quito is some 100 miles distant from the present terminus of the Guayaquil-Quito Railroad. Motor cars are used to convey freight from the railroad to the city.

ELECTRICITY FOR MEXICAN MINES.—The Guerrero Mining & Exploration Company, in which Mr. Alfred B. Adams is largely concerned, proposes to employ electricity for the purpose of operating its mining properties located in the State of Guerrero, Mexico. Power will be derived from the Las Juntas River. There is a 125-ft. waterfall available. About 2,000 hp will be developed. Mr. Ferdinand McCann, of Mexico City, is the engineer of the company.

TURBO-GENERATOR FOR NYACK, N. Y.—Sanderson & Porter, New York City, acting on behalf of the Rockland Light & Power Company, of Nyack, N. Y., have placed a contract with the Westinghouse Company for a Westinghouse-Parsons turbo-generator, 3,300 volts, 60-cycle, two-phase, 400-kw capacity, which will serve as additional lighting equipment.

TROLLEY WIRE FOR ENGLAND.—The Ansonia (Conn.) Brass & Copper Company has secured a contract through J. G. White & Co. for about 100 miles of trolley wire—00 and 000—for use in the construction of one of the extensive British municipal electric traction systems which J. G. White & Co., of London, are carrying out.

Financial Intelligence.

THE WEEK IN WALL STREET.—The hardening rates for money caused a depression on the stock market. The market was quite strong early in the week, but it lost character by Wednesday, and although manipulation resulted in higher prices for some stocks, there was evidently a good deal of liquidation. Among the industrials considerable strength developed in the equipment group, American Locomotive being particularly prominent, the large orders which railway companies are placing for cars and engines creating a bullish feeling in regard to this class of stocks. Metropolitan Traction and Metropolitan Securities developed strength in the face of the later weakness of the general list, but the other traction stocks were not especially influenced by the collapse of the New York Subway strike. The United States Steel shares receded with the rest of the market, and the annual report of the corporation, which

appeared last week, while the street found many interesting details in it, was without speculative influence, representing, as the showing did, past conditions in connection with the property and the steel trade. There were no features in electric stocks and in most cases the changes in quotations were fractional. Allis-Chalmers showed weakness, the extreme prices of the common stock being 15¾ and 17⅛, closing at 16⅛; preferred closed at 60⅞, a loss of 1⅛ points, the lowest and highest quotations being 59 and 62, respectively. General Electric fluctuated between 187 and 192, and closed at 188⅞, a net gain of ⅞. Westinghouse common lost 1⅛ points net, closing at 181¼. There was an active trading in Brooklyn Rapid Transit at prices ranging between 66 and 68, the closing quotation being 67, a net gain of ⅜ point. Metropolitan Street Railway closed at 123¾, thus gaining ½ point net. Interborough Rapid Transit lost 6 points net, closing at 213. American Telephone & Telegraph made a gain of ¼, closing at 146. Western Union Telegraph gained ¾ point, closing at 94¾, and Electric Storage Battery lost 1¼, closing at 86½. The curb market showed strength during the early part of the week, but later there were general declines in sympathy with stock exchange movements, with losses of 1 to 2 points in some cases. Following are the closing quotations of March 21:

NEW YORK

	Mar. 14	Mar. 21		Mar. 14	Mar. 21
Allis-Chalmers Co.	16⅛	16	Electric Vehicle pfd.	21	21
Allis-Chalmers Co. pfd.	60⅛	59	General Electric.	187⅛	187
American Tel. & Cable.	91	90	Hudson River Tel.	...	...
American Tel. & Tel.	144	144	Interborough Rap. Tran.	214	215
American Dist. Tel	33	32	Metropolitan St. Ry.	122⅛	123⅜
Brooklyn Rapid Transit.	66¾	66¾	N. Y. & N. J Tel.	..	..
Commercial Cable.	..	..	Marconi Tel.	..	..
Electric Boat	38	39	Western Union Tel.	94⅛	93
Electric Boat pfd.	79	83	Westinghouse com	181	180¾
Electric Lead Reduction	¼	¼	Westinghouse pfd	190	190
Electric Vehicle	12	12			

BOSTON

	Mar. 14	Mar. 21		Mar. 14	Mar. 21
American Tel. & Tel.	145¾	144	Western Tel. & Tel. pfd.	*103	*101½
Cumberland Telephone.	121	121	Mexican Telephone.	1¾	1¾
Edison Elec. Illum.	252	253	New England Telephone.	137	137
General Electric.	187½	187	Mass. Elec. Ry.	*18⅜	18⅜
Western Tel. & Tel.	20⅛	20	Mass. Elec Ry. pfd.	*64⅛	63

PHILADELPHIA

	Mar. 14	Mar. 21		Mar. 14	Mar. 21
American Railways.	52½	52	Phila. Traction.	..	100
Elec. Storage Battery.	85½	85	Phila. Electric.	10¼	10⅜
Elec. Storage Battery pfd.	..	..	Phila. Rapid Trans.	29¾	30¼
Elec. Co. of America	12	12			

CHICAGO

	Mar. 14	Mar. 21		Mar. 14	Mar. 21
Central Union Tel.	..	..	National Carbon pfd.	114	113
Chicago Edison.	..	..	Metropolitan Elev. com.	22	23¼
Chicago City Ry.	..	199	Union Traction.	*13	11
Chicago Tel. Co.	..	..	Union Traction pfd.	*51	43
National Carbon.	43	44			

* Asked.

INDIANA & MICHIGAN BONDS.—The Indiana & Michigan Electric Co., which concern through its constituent companies generates electricity for lighting and power purposes in the lower St. Joseph River Valley, is perfecting financial arrangements for building another large hydro-electric plant. The company, of which Mr. Charles A. Chapin, of Chicago, and Mr. H. Hobart Porter, of Sanderson & Porter, New York City, are directors, and Mr. F. A. Bryan, of South Bend, Ind., general manager, controls the St. Joseph & Elkhart Power Company's 6,000-kw plant, located near Mishawaka, seven miles from South Bend and ten miles from Elkhart. The Buchanan (Mich.) plant, which has at present a 1,500-kw installation, is also operated by the company. The South Bend Electric Company, which distributes the power in the city of that name, and the Elkhart Electric Company, which carries on an electric lighting and power business in Elkhart, are also among the constituent companies. The new plant will be constructed at Berrien Springs. The dam will be built for the full capacity of the river, which is 6,000 kw. The installation in the power house will have an initial capacity of some 2,000 kw, which will be added to as occasion requires. Construction work, under the supervision of Sanderson & Porter, will commence as soon as the necessary permission is secured from the United States War Department, all the navigable rivers being under its jurisdiction. The Indiana & Michigan Company's authorized stock capitalization is $2,000,000, of which $134,600 is reserved in the treasury. There are $750,000 worth of first lien 5 per cent. gold bonds already issued, out of the $1,500,000 authorized. The actual cash invested in the company's properties exceeds $2,250,000. Following is a statement of earnings for the year ending December 31 last: Gross, $214,338.88; operating expenses, including taxes, $109,404.93; net earnings, $104,933.95; interest charge, $37,500; surplus, $67,433.95.

DIVIDENDS.—The directors of Interborough Rapid Transit have declared a divedend of 1¾ per cent. on the capital stock, payable April 4. The American Telephone & Telegraph directors have declared the regular quarterly dividend of 1½ per cent., payable April 15. Otis Elevator directors have declared the regular quarterly dividend of 1½ per cent. on the preferred stock and the usual dividend of 2 per cent. on the common stock, payable April 15. The directors of the Detroit United Railway have declared the regular quarterly dividend of 1 per cent., payable May 1. The directors of the General Electric Company have declared the regular quarterly dividend of 2 per cent., payable April 15. The directors of the Rochester Railway Company have declared the regular quarterly dividend of 1¾ per cent. upon the preferred stock, payable April 1. The Union Switch & Signal directors have declared the regular quarterly dividend of 2½ per cent. on the preferred and the regular quarterly dividend of 2 per cent. on the common. Both are payable April 10. The directors of the Mackay Companies have declared the regular quarterly dividend of 1 per cent. on the preferred stock, payable April 10. Directors of the Chicago Telephone Company have declared the regular quarterly dividend of 2½ per cent., payable March 31. Directors of the Westinghouse Electric & Manufacturing Company have declared the regular quarterly dividend of 2½ per cent. on the preferred and the assenting and non-assenting stocks, payable April 10.

HAVANA ELECTRIC COMPANY reports for the year ended December 31:

	1904.	1903.
Gross	$1,247,486	$1,061,729
Expenses and taxes	724,746	641,832
Net	$522,740	$419,897
Other income	23,138	22,779
Total income	$545,878	$442,676
Charges	408,270	412,441
Surplus	$137,608	$30,235

In his annual report, President Edwin Hanson says in part: "The gross earnings of the electric system show a very satisfactory increase over the previous year, the gross for 1904 showing an increase of about 12½ per cent., and it is expected that there will be an equally steady increase for the year 1905. The capital expenditure account for the year has not been increased, but during the year there has been spent a considerable sum in special renewals for new cars, car barn, car shops and permanent granite block paving, etc., all of which has been charged to operating expenses. Had this policy not been adopted, the amount carried forward to credit of profit and loss account would have been increased, but after providing the ordinary operating expenses, interest on loans and funded debt, and the considerable sum above referred to for special renewals and improvements, there still remains a balance to the credit of profit and loss account of $138,152.87. Instead of purchasing cars in the United States, the company decided to construct its own rolling stock, and the necessary plant and shops having been provided, we are now building our own cars, and satisfactory results from this change may be anticipated."

MEXICAN TELEPHONE.—At an adjourned special meeting of the stockholders of the Mexican Telephone Company it was voted to sell the company's plant to the Mexican Telephone & Telegraph Company. The latter concern was recently organized under the laws of the State of Maine and has an authorized capital of $1,000,000, of which $300,000 is preferred stock and $700,000 common stock. The basis of exchange will be three shares of new stock, of which one share will be preferred, for each nine shares of the stock of the old company. There are outstanding about $1,800,000 stock of the Mexican Telephone Company, so that there will remain in the treasury of the new company close to $400,000.

CALIFORNIA GAS & ELECTRIC CORPORATION.—The comparative financial statement of the California Gas & Electric Corporation for the months of January, 1904 and 1905, is as follows:

	1904	1905.	Increase.
Gross earnings	$276,513.05	$432,026.77	$155,513.72
Exps., op., taxes, int., ins., etc.	183,529.62	306,186.27	122,656.65
Profit	92,983.43	125,840.50	32,857.07
Corporation bond interest	33,333.33	36,722.23	3,388.90
Balance	59,650.10	89,118.27	29,468.17
Sinking fund	12,500.00	12,500.00	.....
Net surplus	47,150.10	76,618.27	29,468.17

AMERICAN TELEPHONE & TELEGRAPH.—Subscriptions to the new issue of $25,000,000 4 per cent. gold bonds of the American Telephone & Telegraph Company are being received in London by Baring Bros. & Co., Limited, in Amsterdam by Hope & Co.; in Boston by Kidder, Peabody & Co.; in New York by Baring, Magoun & Co.; in Philadelphia by Edward B. Smith & Co.; in St. Louis by the St. Louis Union Trust Company, and in Chicago by the First Trust and Savings Bank.

MEXICAN TELEPHONE.—At a meeting of the stockholders of the Mexican Telephone Company the plan to sell their property to the Mexican Telephone & Telegraph Company was approved. The new company is capitalized at $1,000,000. Holders of stock of the old company will receive new stock on a basis of one share of preferred and two shares of common for nine shares of old stock.

UNITED STATES TELEPHONE.—The directors of the United States Telephone Company have organized for the year with the reelection of the present officers. The preferred stock will get 6 per cent. during the year at the rate of 1½ per cent. quarterly, payable April, July, October and January. Of the authorized issue of $500,000, about half is outstanding.

General News of the Week

The Telephone.

CHINO, CAL.—The Home Telephone Company has been incorporated in this place and will at once build and equip 20 miles of telephone line through Chino to Pomona.

RIVERSIDE, CAL.—The Southwest Home Telephone Company has been granted a franchise to extend lines to San Jacinto, Perris and the Perris Valley country. The company is to expend $15,000 in improvements within one year and another $5,000 before the end of the third year. The main line with laterals will be more than 30 miles long.

AUGUSTA, GA.—The independent telephone plant of Augusta was sold March 7, at auction, for $15,000, the purchaser being a representative of the bondholders. It is believed that the Southern Bell Company was interested in the deal. The original cost of the plant was $100,000. It will be dismantled.

PARIS, ILL.—The Wabash Valley Telephone Company has changed its headquarters from Marshall to Paris.

PEKIN, ILL.—The Farmers' Telephone Company, of Hopedale, has increased its capital stock from $5000 to $20,000.

ALTON, ILL.—The stockholders of the Farmers' Mutual Telephone Company have changed the name of the company to the Star Telephone Company.

UPPER ALTON, ILL.—The Fosterburg & Upper Alton Main Telephone & Telegraph Company has changed its name to the Star Telephone & Telegraph Company.

WATAGA, ILL.—The Wataga Farmers' Mutual Telephone Company has re-elected the present officers as follows: president, E. P. Robson; secretary, Andrew Anderson and treasurer, W. N. Giles.

STREATOR, ILL.—The directors of the Bureau County Independent Telephone Company voted at a late meeting to recommend to the stockholders that the capital stock be raised from $120,000 to $200,000.

RANKIN, ILL.—J. H. Davis and another Boswell man have just completed a deal whereby they come into possession of the telephone exchanges of East Lynne, Cissna Park and Rankin, Ill., paying $18,000 for the same. The three exchanges were put in by the Fountain Creek Telephone Company about two years ago and have more than 500 telephones in operation, and is on a money-making basis. The Boswell people took possession March 1.

SHELBYVILLE, IND.—The Mutual Telephone Company, of this city, is contemplating extensive improvements, and has an engineer at work preparing plans and specifications for an entire new plant.

TELL CITY, IND.—The Eckerty, Cannelton & Branchville Telephone Company is asking for a franchise in Tell City. The company is proposing to extend its lines to this city, and it is believed the franchise will be granted.

HOPE, IND.—The Town Board has granted a fifty years' franchise to the Hope Telephone Company. By reason of a singular discovery it was learned that the Hope Telephone Company had been operating for six years without a franchise.

LIBERTY CENTER, IND.—The Liberty Center Telephone Company has increased its capital stock from $2500 to $25,000 for the purpose of extending the plant and installing modern appliances and improving the entire system. James P. Morrisey is president and Edward M. Collier, secretary.

CRESTON, IND.—The Northwestern Telephone Company of Indiana, has filed articles of incorporation with the Secretary of State. The capital stock is $10,000. The company will establish an exchange in Creston and construct and operate telephone lines throughout Lake County. A. G. Taylor, Chas. Thompson, H. E. Vumedge and others are the incorporators.

SANFORD, IND.—The Sanford Mutual Telephone Company has filed articles of incorporation with the Secretary of State. The capital stock is $5000, all paid in. The company will build an exchange at Sanford and extend telephone lines throughout Vigo, Vermillion, Park and Sullivan counties, J. W. S. Wolfe, C. A. Ray, Wellon Smith and Wm. J. Tritt are the directors.

SOUTH BEND, IND.—The directors of the South Bend Telephone Company have arranged to introduce an automatic system. As a beginning toward this improvement the directors ordered boards for 500 telephones at a cost of $16,000. Incidental to the change and other improvements the officials have announced that there will be an increase in the rentals from $30 to $36 a year for business houses, and from $20 to $24 for residences.

INDIANAPOLIS, IND.—Two new telephone companies have filed articles of incorporation here. The New Winchester Farmers' Mutual Telephone Company will build an exchange in New Winchester. Francis Sheets, Harvey Hays and Henry Beckley are the directors. The Farmers' Union Telephone Company will build an exchange in Borden. C. M. Collins, Henry McKinley, Jas. H. Miller, Louis C. Johnson, A. C. Fordyce, B. F. Brown and Denis McKinley are the directors.

MILFORD, IA.—The Midland Telephone Company has received a twenty-five-year franchise in this place.

DES MOINES, IA.—The Calumet Telephone Company has been incorporated with a capital stock of $1000, by Lewis Mead and others.

DES MOINES, IA.—A new telephone system is to be installed in the court house of this city by the Bergen Electric Company at a cost of $6970.

SIOUX CITY, IA.—The Bronson Telephone Company has been incorporated with a capital stock of $5000. The incorporators are M. G. Smith, H. H. Onstot, D. B. Semple, D. D. Law and George W. Elliott.

IOWA FALLS, IA.—The annual meeting of the stockholders of the Central Iowa Telephone Company has been held. The following officers were elected: President, F. E. Wettstein; vice-president, J. H. Funk; secretary and treasurer, W. V. Shipley.

BURLINGTON, IA.—Articles of incorporation have been filed by the Irish Ridge Road Telephone Association. The officers are E. A. Reid, president; Henry Oetken, treasurer; Jos. Koestner, secretary; Fred Schienge, W. I. Steingraeber and E. A. Reed, directors.

DAVENPORT, IA.—It is stated that the Davenport & Tipton Telephone Company, whose head office is located at Tipton, is unable to meet its debts, which amount to about $18,000, and is about to be sold. The property is said to be a valuable one and if properly handled will pay good dividends, especially the Tipton exchange, which is on a good paying basis.

IONIA, KAN.—The Limestone Farmers' Telephone Company has been formed with $5000 capital.

IUKA, KAN.—The Farmers' Union Telephone Company has been incorporated. Capital stock, $8000.

BARBOURVILLE, KY.—The Cumberland River Telephone Company has been organized with a capital stock of $25,000 to put in copper circuits between London, Barbourville and Jellica, on the Tennessee State line, where connection will be made with the People's Telephone Company, which has copper lines into Knoxville and East Tennessee. John Woodward, of London, Ky., is at the head of the movement. Central Kentucky companies which have iron circuits, are arranging to put in copper lines to London to connect with the new company.

APPLETON, ME.—The West Appleton Telephone Company has been incorporated with a capital stock of $10,000. A. Millett, of Searsmont, is president, and C. R. Bartlett, of this city, treasurer.

MILFORD, MASS.—Plans for the reorganization of the Citizens' Telephone Company have been marked out, and the capital stock has been increased from $100,000 to $150,000.

DAYBURG, MICH.—The annual meeting of the South Butler Telephone Company has been held and the following officers were elected: President, F. L. Holmes; vice-president, W. F. Ramsdell; secretary, F. D. White; treasurer, Geo. Ransford.

RUSHMORE, MINN.—The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $25,000.

MANKATO, MINN.—The Northwestern Telephone Exchange Company's change was wrecked by fire, with a loss of $8,000.

CABLE, MINN.—A company has been organized here for the purpose of connecting this place with St. Cloud by a telephone line. Henry Miller is president of the company.

EXCELSIOR, MINN.—It is understood that the Twin City Telephone Company, of Minneapolis, will establish an exchange in this city and around the lake in the spring.

LAKE CITY, MINN.—The Dwelle Telephone Company has been incorporated with a capital stock of $100,000. The incorporators are C. M. Dwelle, G. W. Patton, Wm. G. Ball and G. H. Hammond.

BEARDSLEY, MINN.—The Gopher Telephone Company has been incorporated with a capital stock of $50,000. The incorporators are A S. Stephens, John Minkiewitz, Jr., L. G. Westfall and J. D. Weir.

FARIBAULT, MINN.—The Rice County Rural Telephone Company has filed articles of incorporation. The capital stock is $100,000. The officers are A. G. Chase, president; Isabella G. Chase, vice-president; W. T. Mollison, secretary and treasurer. The company will begin at once to install the plant.

HECTOR, MINN.—The Hector Telephone Exchange, recently organized, has purchased the old system from W. B. Strom and elected the following officers: John Hokanson, president; E. M. Ericson, vice-president; H. L. Torbenson, secretary; G. S. Eichimeser, treasurer. Forty miles of new line will be built this season.

HOUSTONIA, MO.—The merchants and farmers at Houstonia have formed a local telephone company and will put in an exchange. The officers are M. P. Tuck, president; Dr. C. T. McConnell, secretary; Glen Robertson, treasurer.

MEXICO, MO.—At the annual meeting of the Laddonia, Rush Hill & Mexico Telephone Company, D. L. Rodgers was elected president to succeed J. N. Rosser. The other officers elected are: E. A. Feutz, secretary, and John Fry, J. W. Rosser and Earl Cunningham, directors.

LINCOLN, NEB.—The Staplehurst Telephone Company, with an authorized capital of $5000, has filed articles of incorporation with the Secretary of State.

KENESAW, NEB.—The annual meeting of the stockholders of the Kenesaw Telephone Company was held recently when a dividend of 10 per cent. was declared on last year's business. New lines will be built and those now in will be extended just as soon as the weather permits. A board of directors and the following officers were elected: W. Z. Parmenter, president; A. S. Howard, vice-president; E. E. Schultz, secretary, and H. R. Coplin, treasurer.

HOPE, N. D.—The capital stock of the Union Telephone Company is to be increased from $50,000 to $100,000.

GRAND FORKS, N. D.—The Tri-State Telephone Company has asked for a franchise permitting the establishment of a telephone system in this city in connection with its exchange in Grand Rapids.

ALBANY, N. Y.—The ordinance authorizing the placing of telephone, tele-

graph wires, cables, etc., on South Pearl Street,, underground, has been passed by unanimous consent.

CLINTON, N. Y.—The Clinton Home Telephone Company, of Clinton, has been incorporated with a capital stock of $25,000. The directors are C. D. Hayes, G. J. Cauldwell and H. S. Powell.

ALBANY, N. Y.—The Cassidy bill, permitting telephone, lighting and other electric power corporations to take land for the transmission of power by condemnation proceedings, has been favorably reported by the Senate Committee on Miscellaneous Corporations by unanimous vote. A similar bill has been introduced in the Assembly by Mr. Leggett.

FITCHVILLE, OHIO.—The Clinton Air Line Telephone Company has increased its capital stock from $1000 to $10,000.

PLEASANT HILL, OHIO.—The Pleasant Hill Telephone Company has increased its capital stock from $10,000 to $20,000.

HAMILTON, OHIO.—The stockholders of the Hamilton Home Telephone Company voted to increase the capital stock of the company from $200,000 to $300,000.

MT. VERNON, OHIO.—The Ohio Bell Telephone Company has been incorporated with a capital stock of $20,000, by T. P. Sylvan, E. H. Huntsberger and others.

EAST PALESTINE, OHIO.—A stock company has been organized for the purpose of providing Unity Township with a rural telephone service. The capital stock is $8000.

OTTAWA, OHIO.—The Boomerline Mutual Telephone Company has been incorporated by H. J. Hermiller, B. T. Meyer, H. W. Kohls, Jerome Kohls, Gust. Redd and George Pierman.

WEST CARROLLTON, OHIO.—The Montgomery County Telephone Company, a branch of the Home Telephone Company, has been granted a franchise here and will install a system at once.

UNION FURNACE, OHIO.—The Pioneer Telephone Company has been incorporated with a capital stock of $2000. The incorporators are A. F. Woodward, E. W. Sanner, D. A. Frey, W. J. Bethel and E. R. Woodward.

MT. EPHRAIM, OHIO.—The Coens Telephone Company has been incorporated with a capital stock of $5000. The incorporators are H. G. Riggs, J. A. Rich, William Miley, L. M. Danford, Frank Miley and Levi Milhone.

LINDENVILLE, OHIO.—The Wayne Telephone Company has been incorporated with a capital stock of $6000. The incorporators are S. A. Babcock, R. P. Miner, A. C. Bogue, William Dolan, K. Dillon and O. H. Ketcham.

CLEVELAND, OHIO.—A long-distance independent telephone line has been completed between Cleveland and Buffalo. This permits service between Cleveland and New York State points, including Rochester, Syracuse and cities in that territory. The companies participating in the new service are the United States Telephone Company, of Cleveland, which operates a line to the Ohio State line; the United Telephone Company, of Pennsylvania, and the Frontier Telephone Company, which operates into Buffalo.

KIEL, OKLA.—The Dover & Kiel Rural Telephone Company, of Kiel, has been incorporated with a capital stock of $5000. The incorporators are B. F. Watson, W. R. Barner, J .W. McClelland and H. W. Jameson, of Dover, and William Chalker, of Kiel.

HECLA, S. D.—The Hecla Telephone Company contemplates extending its lines to Aberdeen.

MILBANK, S. D.—The Grant County Telephone Company, a mutual concern, has been organized at Milbank.

ELMORE, S. D.—The Eastwood Telephone Company, of Elmore, Ottawa County, has been incorporated by J. E. Steinkamp, Homer Metzgar, Taylor Fuller, Fred Windisch and George W. Luckey, capital $50,000.

GRAND FORKS, S. D.—The Tri-State Telephone Company, of Grand Forks, S. D., began giving service Jan. 27, with its new exchange equipment furnished by the Stromberg-Carlson Telephone Mfg. Company, Rochester, N. Y. The company starts out with a good-sized list of subscribers and reports that it is adding to this list rapidly from day to day.

SABINAL, TEX.—The Sabinal Telephone Company has been incorporated with a capital stock of $3000. The incorporators are Morton Swift, R. P. Rainey and G. A. Barker.

GRANGER, TEX.—Messrs. Charles A. Wilson, A. R. Lawrence and H. C. Cooke, all of this place, have bought of R. H. Bradley, of Holland, the telephone exchange of this place. The new management will install a new switchboard and make several other improvements.

RICHMOND, VA.—The Cedar Run Mutual Telephone Company has been incorporated with a capital stock of $5000, by F. S. Ensor, J. L. Carcolvin and others.

RICHMOND, VA.—Rev. D. J. Shophoff is president of a new telephone company recently organied to build a line in the upper part of Stafford County to Falmouth.

LADYSMITH, WIS.—The Chippewa Valley Telephone Company has bought the Prentice exchange and will make improvements, including the stringing of considerable copper wire.

HONOLULU, H. I.—The Standard Telephone Company, Ltd., has asked the Legislature for a franchise to operate an automatic telephone system in Honolulu.

ORILLA, ONT.—The town of Orilla has notified the Bell Telephone Company that it will not make a contract for more than one year as investigation is being made with a view to installing a municipal system.

OTTAWA, ONT.—The city of Ottawa, Ont., has been selected as the location of the head o..ce of the Dominion DeForest Wireless Telegraph Company, which has been incorporated under an Ontario charter, with a capital of $1,200,000. The provisional directors of the company are L. J. Lemieux, F. J. Humphrey, J. C. Cardinal and A. Brassard, all of the city of Montreal, Que.

Electric Light and Power.

LUVERNE, ALA.—The Luverne Electric Light & Water Company, of Luverne, has been incorporated, with a capital of $10,000, by J. R. Horn, J. M. Cody, R. G. Reddach and others.

WEST END, ALA.—The City Council has granted the Birmingham Railway, Light & Power Company, of Birmingham, a franchise to lay gas mains and construct an electric light system in West End.

HARRISBURG, ARK.—A. A. Boone, of Greenfield, writes that bids will be received until about April 15 for the construction of an electric light plant for Harrisburg at a probable cost of $4000.

SANTA BARBARA, CAL.—The City Council have granted a franchise to the Merchants Mutual Electric Light & Power Company.

SEBASTOPOL, CAL.—The Sebastopol Light, Power & Water Company has been incorporated with a capital of $25,000 by W. P. English, G. W. Kingsbury and A. B. Swain, of Sebastopol.

CHESHIRE, CONN.—This town has appointed a committee to investigate the cost of constructing a municipal electric light plant.

NEW HAVEN, CONN.—Residents of the town of Cheshire are desirous of having an electric plant erected there, and a committee has been appointed to make inquiries on the subject. The committee is composed of R. H. Morgan, J. M. Speake and Ira D. Woodley.

WASHINGTON, D. C.—Bids will be received April 1 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing at the navy yards at Mare Island, Cal., and Puget Sound, Wash., a quantity of electric wire, etc. Address H. T. B. Harris, Paymaster-General, U. S. N.

MARSEILLES, ILL.—The water works and electric light plant is now under control of a new corporation, to be known as the Consolidated Water & Light Company, with a capital of $100,000. It is proposed to erect a new power house; the old water works station is to be torn down and the flume enlarged. It is also proposed to put in auxiliary steam power. John M. Nicholson is president and A. E. Cooper, secretary.

OOLITIC, IND.—The Town Board has decided to construct a combined water works and electric light plant at a probable cost of $23,000. Geo. C. Morgan, Chicago, Ill., is the engineer.

CONNERSVILLE, IND.—The general gas, electric light and power plant at this place has been sold to Geo. B. Markle, of Hazleton, Pa., who will expend a considerable sum in improvements.

BICKNELL, IND.—The machinery for the Bicknell Light & Power Company is being installed. The plant is near a number of coal mines, and it is proposed to furnish power and light to these mines, which will be the first mines to be lighted by electricity in Indiana.

INDIANAPOLIS, IND.—Bids will be received April 4 at the Treasury Department, Washington, D. C., for furnishing and installing certain electric and gas fixtures in the U. S. Court House and Post Office here. H. A. Taylor is acting secretary.

LYONS, KAN.—A company has been organized here and secured a 20-year franchise to erect a $10,000 electric light and power plant. An electrical engineer has been engaged to install and operate the plant. An ice plant may be added later. The name of the company appears to be Lyons Electric Company.

BALTIMORE, MD.—The contract for electric lighting in this city for five years has been awarded to the Consolidated Gas, Electric Light & Power Company, at $67.49 per lamp per year.

BARAGA, MICH.—The State Legislature has passed a bill allowing this village to issue $40,000 bonds for electric lights and water works.

ACKERMAN, MISS.—T. F. McGee is reported interested in the construction of an electric light plant.

ROSEDALE, MISS.—It is stated that a committee will procure estimates on the cost of an electric light plant to be operated in connection with the municipal water works.

NEW ALBANY, MISS.—Bids will be received by the Mayor and Board of Aldermen, March 28, for the construction of water works and an electric light plant. W. F. Wilcox, of Jackson, is the engineer.

ST. LOUIS, MO.—In the last monthly report to the president of the Board of Public Improvements by the chief engineer it is stated that the municipal lighting plant installed in the basement of the City Hall less than two years ago has already paid for itself, together with operating expenses and that there is a balance of $323.22 in favor of the city over the cost of lighting municipal buildings for that time. The plant cost the city $35,000. During the time it has been in operation the city would have paid private lighting companies for the same service $48,086.91, while the operating expenses would have amounted to $12,763.69.

ALMA, NEB.—Applications for the position of engineer for the water and electric light plant will be received up to April 15. A. A. Billings is city clerk.

CLINTON, N. Y.—The Governor has signed the bill authorizing this city to issue $7000 bonds for an electric light plant.

BUFFALO, N. Y.—It is stated that the municipality will save $58,374 a year in its expenditure for electric lighting, this being the net difference between the present contract price of $99.92 per lamp and the bid of $67.49 per lamp made by the Consolidated Gas, Electric Light & Power Company. In presenting its bid the Consolidated Gas, Electric Light & Power Company submitted the accompanying statement: This company is the only electric light and power company physically able to undertake the city lighting—that is to

say, the only company equipped with a plant to do the city's work. At the time of bringing together the two lighting interests of the city, viz., gas and electric lighting, the company took occasion to state that where savings could be made by such union of interests it would be the policy of the company to give the city the benefit, as far as possible, of such economies. We are thereby enabled to make the price given in our bid for the service the city demands.

MUSKOGEE, IND. TER.—The Muskogee Grand River Power Company has been incorporated to construct a water power plant of 40,000 horse-power on Grand River, about 11 miles from Muskogee. Surveys have been started, but nothing has been done as yet in the way of definite plans, maps, etc. C. N. Haskell is president, and Carl Pursell, secretary, both of Muskogee.

RALEIGH, N. C.—An ordinance has been offered in the City Council at Raleigh to place all wires in the fire district underground.

SPENCER, N. C.—The Board of Aldermen has awarded to the Salisbury & Spencer Street Railway Company the contract to install a system of electric lights in Spencer, to be in operation by May 15.

BROOKLYN, N. Y.—Bids will be received April 3 by C. B. J. Snyder, Superintendent School Buildings, New York City, for installing electric equipment in School No. 85.

WARREN, OHIO.—Albert S. Allen, of Cleveland, has been directed to prepare plans for a water and light plant for the Trumbull County Court House and jail.

DAYTON, OHIO.—The Montgomery County Electric Company has been incorporated with a capital of $100,000 by Robt. R. Nevin, Fred. A. Funkhouser and others.

SPRINGFIELD, OHIO.—It is stated that if the E. S. Kelly Home Heating, Light & Power Company secures a blanket franchise, it will expend $50,000 this year in improvements.

MAUMEE, OHIO.—The Public Service Company, of Maumee, has been incorporated with a capital of $50,000 for electric lighting and heating purposes. Incorporators: Geo. McGovern, Jas. H. Ragan, Thos. H. Harper, and others.

DOWNINGTOWN, PA.—The electric light plant at Downingtown has been sold to Mr. F. S. North. The sale was effected through the Gas & Electric Development Company, of Philadelphia, which company was recently organized and makes a specialty of selling lighting properties.

GREENVILLE, S. C.—A charter has been granted to the Saluda River Power Company, with a capital of $300,000. It is proposed to develop power 5 miles from this city, to supply textile and industrial enterprises. Lewis W. Parker, A. G. Furman and H. J. Haynesworth are the incorporators.

COOKEVILLE, TENN.—Bids will probably be received April 15 for the construction of water works and an electric light plant, at a cost of $25,000. O. Holliday is city recorder.

HAMILTON, TEX.—The Hamilton Light & Ice Company has been incorporated with a capital of $20,000. Incorporators: W. A. McSpadden, of Cisco, and J. A. Muhl, of Waco.

LYNCHBURG, VA.—A committee is looking into the matter of constructing a municipal electric light plant.

LURAY, VA.—The plant of the Luray Electric Company has just been completed and the company is now in the market for fans and motors for alternating current, 110-volt, 60-cycle, single phase.

ROSWELL, NEW MEX.—The Citizens' Light, Heat & Power Company, of Roswell, has been incorporated with a capital of $100,000. J. A. Buckley, of Kingfisher, Okla. Ter., is one of the incorporators.

TACOMA, WASH.—The City Council has under consideration an offer from the Equitable Finance Company, of Portland, Ore., to construct a hydraulic power plant on Nisqually River, 25 miles from Tacoma, to furnish 5000 hp to the city to take the plant when completed. Frank L. Davis is city engineer.

OTTAWA, ONT.—The Ontario Government has granted incorporation to the North Bay Light, Heat & Power Company, of North Bay, Ont., for the purpose of supplying electricity for light, power and heat. The share capital is $50,000. The directors are T. Wallace, J. T. Lovell and William Martin, of North Bay, and A. F. Leggatt, of Ottawa.

TORONTO, ONT.—The city engineer of Toronto has reported that the estimated cost of installing a municipal lighting plant, with an alternating current sufficient for 1500 arc lights, would be $638,000, which includes buildings but not land. If, on the other hand, power were obtained from Niagara Falls, the cost of lighting to the city would be $475,000.

The Electric Railway.

LITTLE ROCK, ARK.—The Little Rock & Hot Springs Electric Railway Company, with a capital stock of $2,000,000, organized in Little Rock, March 13, by electing the following officers: President, C. J. Kramer, Little Rock; first vice-president, L. Garrett, Springfield, Mo.; second vice-president, A. S. Blodgett, Springfield; secretary, J. C. Marshall, Little Rock, and treasurer, Geo. W. Rogers, Little Rock.

GRINNELL, IA.—The Grinnell Interurban Railway Company, recently organized, has elected officers as follows: President, O. K. Cole; vice-president, B. J. Carney; secretary and treasurer, E. B. Brande.

KANKAKEE, ILL.—The Kankakee & Western Electric Railway Company has been formed with a capital stock of $15,000. Incorporators: John Small, Charles B. Campbell, Charles E. Foley.

CHICAGO, ILL.—The city has forestalled the City Railway Company in filing a suit in which the validity of the 99-year franchise is attacked in several of the most important thoroughfares. The effects of the repeal of the City Railway license will be to leave the railway company without any franchise from the city and without license to operate cars over the streets. The ordinance, however, contains a clause that pending result of the suit the city shall not interfere with the operation of cars or make any effort to prevent such operation. Late last February a syndicate, headed by J. Pierpont Morgan, Thomas F. Ryan, Marshall Field, P. A. Valentine and J. J. Mitchell bought the City Railway Company for $36,000,000.

TELL CITY, IND.—A special election has been ordered for April 10 in Troy township for the purpose of voting on a $38,000 subsidy in aid of the Indianapolis & Ohio Valley Traction Company's electric railway.

OWENSVILLE, IND.—At a special election held March 11 in Montgomery township, Gibson County, a $30,000 subsidy was voted in aid of an extension of the Evansville & Princeton Company's line through this part of the county.

COVINGTON, IND.—The City Council has granted a 50-year franchise to the Fountain-Warren Traction Company, which proposes to build a line from Lafayette to Danville, Ill., via Covington. The company's headquarters will be in this city.

MUNCIE, IND.—The Muncie, Hartford City & Fort Wayne Traction Company has filed a mortgage for $1,000,000 on its property in favor of the Guardians' Savings & Trust Company, of Cleveland, O. The money derived will be used to complete a branch line north from Bluffton to Fort Wayne this summer.

SPRINGFIELD, MASS.—The sale of the Springfield Street Railway Company to the New York, New Haven & Hartford Railroad is stated to be closed at $235 per share. The company has 65 miles of track and is capitalized at $1,958,400. Later information states that this report is premature.

WORCESTER, MASS.—Options are being secured by the Worcester & Northern Street Railway Company on land necessary for the construction of its proposed line from the terminus of the Worcester & Holden line in Jefferson to Wachusett Mountain.

GREENFIELD, MASS.—The shareholders of the Greenfield & Turners Falls and the Greenfield, Deerfield & Northampton have voted to consolidate with the Northampton & Amherst Street Railway Company, and the last-named company has applied to the Massachusetts State Railroad Commission for permission to increase its capital stock from $180,000 to $490,000, to take up the stock of the absorbed companies. Later on it is proposed to change the name of the company to the Connecticut Valley Street Railway and to increase the stock to $500,000.

NEW YORK, N. Y.—An application by the Long Island Railroad Company to be permitted to dig necessary trenches for the installation of the third rail on the surface of Atlantic Avenue, Brooklyn Borough, from Atkins Avenue to the borough line, a distance of eighteen blocks, has been denied by Borough President Littleton and Public Works Commissioner Brackenridge.

ALBANY, N. Y.—Another important street railway bill has been introduced in the Assembly at Albany, providing for the payment annually of a percentage of the gross earnings of street railways into the treasury of all cities of the State. The present law relates only to New York City. The proposed bill amends the law as to include all cities of the second and third class. It provides that on Nov. 1, each year, the street railway company shall pay to the sinking fund of the city three per cent. of its gross earnings for the first three years and five per cent after five years.

NEW ROCHELLE, N. Y.—As a preliminary to transforming its Harlem River Branch into a six-track electric road, the New York, New Haven & Hartford Railroad Company has obtained an order from Justice Keogh of the Supreme Court appointing commissioners to condemn lands for improvement in New Rochelle. The company is planning to spend from $6,000,000 to $10,000,000. It is said to be the intention of the company to build a $200,000 terminal which will be used for the main and suburban lines and for the New York & Stamford trolley road, as soon as its tracks can be extended to New Rochelle.

NEW YORK, N. Y.—It is expected that the Rector Street Station of the Subway extension to Brooklyn will be opened for traffic on April 2, and it is hoped that trains will be running to the Battery not later than July. The Rector Street Station will be one of the most important in the Subway. In the center almost of the financial district, it will accommodate thousands who now have to use the elevated and surface cars or to walk up to Fulton Street. The platforms are 350 feet long, and this length and their great width will accommodate large crowds. There will be entrances from Wall Street and Rector Street and from the Empire Building and New Street by means of an underground pathway.

UTICA, N. Y.—The Utica & Mohawk Valley Railway Company has closed a contract with the Hudson River Electric Power Company for power for use on the Utica & Mohawk Valley Railway Company's lines and extensions thereof, and also for power for the operation of cars between Syracuse and Utica. The contract takes effect July 1, upon which date power is to be delivered in Utica for use upon the lines of the Utica and Mohawk Valley. The Power Company will build a large steam plant in Utica which will be added to from time to time as the demand for power requires. The contract is for 3000 kilowatts at present, with the right to take up 15,000 kilowatts. The term of the contract is 25 years. Mr. C. E. Parsons, chief engineer of the Hudson River Electric Power Company, is the man on the ground.

ROCHESTER, N. Y.—At the annual meeting of directors and stockholders of the Rochester Railway Company, C. M. Clark, of Philadelphia, was elected president to succeed Frederick Cook, deceased. The other officers elected were: Vice-president, H. D. Walbridge, New York; vice-presi-president, A. H. Harris, Rochester; treasurer, G. L. Estabrook, Philadelphia; secretary and assistant treasurer, G. G. Morehouse; assistant secretary, C. Ford Stevens, Philadelphia; general manager, R. E. Danforth. In connec-

tion with the annual meeting of the Rochester Railway Company, the election of officers of the Rochester & Sodus Bay Railway Company resulted as follows: President, Granger A. Hollister; vice-president, C. M. Clark; secretary and treasurer, George G. Morehouse.

WINSTON-SALEM, N. C.—The town of Winston-Salem has, through the board of trade, named a committee to appoint a date for voting on a $37,000 bond issue to aid in the building of the proposed electric railway to High Point, N. C.

ZANESVILLE, OHIO.—The Muskingum, Coshocton & Tuscarawas Electric Railway Company has been incorporated by John J. Adams, J. R. Alexander and H. I. Buell, of Zanesville; F. L. Mooney and W. T. Koontz, of Woodsfield, and recently elected the following officers: President, Judge J. J. Adams; secretary-treasurer, J. R. Alexander; chief engineer, Henry Buell.

BLOOMDALE, OHIO.—S. P. Douglass, of Toledo, is promoting the North Baltimore, Bloomdale & Eastern Electric Railway. The road will be about 12 miles long, extending from Fostoria to North Baltimore, where connection will be made with the Toledo, Bowling Green & Southern Traction Company, for Toledo. It will touch four towns.

MAHANOY CITY, PA.—The Schuylkill Traction & Lake Side Railway, which operates 30 miles of street railway in Mahanoy Valley, and which is owned by Philadelphia capitalists, is reported purchased by a local syndicate for $1,200,000.

PHILADELPHIA, PA.—The elevated and the subway lines of the Philadelphia Rapid Transit Company will be equipped with a protected third rail. It was reported at one time that the surface contact system was being seriously considered.

DALLAS, TEX.—It is reported that the Texas & Pacific Railroad is desirous of securing control of the Northern Texas Traction Company, operating between Dallas and Fort Worth.

GRAHAM, VA.—The Bluestone Traction Company has been incorporated with a capital stock of $100,000 to build electric railways in Virginia. The officers of the company are: President, John Walters, vice-president, J. N. Sluss; treasurer, Edwin Mann.

WALLA WALLA, WASH.—Edwin S. Isaacs has been granted by the council a 25-year franchise for the construction of a street car system in Walla Walla.

MILWAUKEE, WIS.—It is reported that the Milwaukee Electric Railway & Light Company will install a printing plant of its own to print tickets, blanks, etc.

MILTON, ONT.—James Waldbrook, of the Halton County Council, will probably build an electric railway from a point on the line of the Toronto & Hamilton Electric Railway to run northerly through Milton, Georgetown and Acton.

KINGSTON, ONT.—Mr. J. M. Campbell, of this city, is the engineer for the construction of the Edmonton, N. W. T., electric railway. He has concluded the awarding of tenders. A Montreal firm is building the road, which will be about five miles long, and will soon probably be extended to neighboring villages. The cost will be $17,000 per mile. The power plant will cost $20,000. The road will be ready for operation in September next.

New Industrial Companies.

THE BERGGREN ELECTRIC COMPANY, of St. Paul, has been formed; capital stock, $50,000. The incorporators are E. T. Berggren, Godfrey N. Beggren and George Brown.

THE BENARD ARC LIGHT COMPANY has been organized at Chicago to manufacture and deal in electric light fixtures and appliances. J. O'Donohue, Peter F. Daly and William J. Moore are the incorporators.

THE EMPIRE ELECTRIC STAGE LIGHTING COMPANY, of New York City, has been incorporated with a capital stock of $3,000. The directors are A. V. Bourke, J. J. Kramer and Frank Riall, of New York City.

THE CLIMAX CONSTRUCTION COMPANY, of New York City, has been incorporated with a capital stock of $200,000 to construct gas and electrical works. The directors are W. G. Root, S. M. Neff and O. S. Maurice, of New York.

THE MONTGOMERY COUNTY ELECTRIC COMPANY, of Dayton, O., has been incorporated with a capital stock of $100,000. The incorporators are Robert R. Nevin, F. A. Funkhouser, Fred. G. Withoft, Robert R. Knowles and W. R. Craven.

THE GLOUCESTER COUNTY ELECTRIC COMPANY, of Woodbury, N. J., has been incorporated with a capital stock of $50,000. The incorporators are Enos R. Artman, Manasses K. Treichler, Daniel G. Endy, Albert Buys and Edward F. Johnston.

THE SIMPLEX COMPANY has been organized to manufacture electrical measuring instruments at 60 Nassau Street, Newark, N. J. It has a newly equipped factory, with all the latest machinery and appliances for carrying on such business. The president of the Simplex Company is Mr. M. C. Rypinski, who until recently had charge of the business of the Empire Electrical Instrument Company, New York, and previous to that had a lengthy experience with the General Electric Company. Mr. Rypinski's experience covers a period of 12 years and his operations have been confined along those of measuring-instrument lines. He also has surrounded himself with a very competent staff of assistants and the outlook is most promising for the success of the Simplex Company.

Legal.

SAGGING WIRES.—The case of Weed vs. the City of Columbus, Ind., has been appealed to the Supreme Court. John W. Weed came in contact with a telephone wire on his own premises which had been heavily charged with electricity by reason of a municipal electric light wire sagging and coming in contact with the telephone wire. Weed was killed by the shock, and the city was held responsible by the Coroner's verdict. A suit for damages resulted. The city demurred to the complaint on the ground that when a municipal corporation maintains something for public utility and where there is no gain for the utility, a person cannot recover damages. This was construed to cover the electric light plant, and the court sustained the demurrer. The question was then taken to the Supreme Court.

Personal.

MR. CHARLES A. MOORE, of Manning, Maxwell & Moore, has resigned from the directorate of the Niles-Bement-Pond Company.

MR. E. J. DE SABLA, JR., president of the California Gas & Electric Corporation, San Francisco, was on a visit to New York, this week.

MR. ANDREW CARNEGIE.—A despatch from Syracuse, N. Y., states that Mr. Carnegie has given $150,000 to the Syracuse University Library.

MR. HUGH HAZLETON has resigned as electrical engineer for the Manhattan Railway Division of the Interborough Rapid Transit Company.

MR. H. C. ADAMS, JR., has resigned from the Clifton Mfg. Company to accept a position with Mr. R. B. Corey, Havemeyer Building, New York.

MR. P. V. DEGRAW, of Washington, D. C., an ex-telegrapher and well-known newspaper man, has been appointed by President Roosevelt to the position of Fourth Assistant Postmaster-General.

MR. B. J. ARNOLD was a guest last week of the Commercial Club of Boston, before which he delivered an address on electric traction for steam railroads. Prof. Elihu Thomson is president of the Club.

MR. FRANCIS W. JONES is the subject of a cartoon in the New York *Evening Mail's* series of rhymed and illustrated notices printed under the head "Men of Affairs." The notice appears in the issue of March 18.

MR. ADOLPHUS A. KNUDSON has taken offices in the Mutual Life Building, New York, where he will continue his practice as consulting engineer, with electrolytic surveys upon piping systems, etc., as a specialty.

MR. W. K. FREUDENBERGER, formerly superintendent of the electrical department of the Colorado Fuel & Iron Company, has accepted the position of Electrical Engineer of the American Steel Foundries, with headquarters at the New York office.

MR. H. N. LATEY has had his duties as electrical engineer, Subway Division, Interborough Rapid Transit Company, extended to the Manhattan Railway Division. He will hereafter be known as Electrical Engineer for the Interborough Rapid Transit Company.

PROF. GEORGE E. WASCHE, of the Civil Engineering Department of Purdue University, Lafayette, Ind., has been granted a leave of absence until September 1. He will investigate water powers suitable for electric generation along the White, the Ohio, the Tippecanoe and Wabash Rivers.

PROF. S. M. WOODWARD, of the State University of Iowa, presented two papers before the recent annual meeting of the Iowa Engineering Society, with the following titles: "The Effect of Floods on the Water Power of Streams," and "Power Capacity of a Running Stream Without Storage."

MESSRS. JOAQUIN G. SALAZAR and Antonio Alvarez Sardanela, of Mexico City, have been commissioned by the Mexican Government Department of Communications to visit the United States, principally with a view to making a study of the manufacture of telegraph and telephone wire cables. They are expected here next week.

MR. P. G. GOSSLER, vice-president of J. G. White & Co., New York City, has left on a trip to Mexico in connection with the Monterey Electric Light & Power Company, Ltd., of which concern he is president. The Monterey Company holds the franchise of lighting the city of Monterey. The undertaking is controlled by J. G. White & Co. and the New York banking house of H. W. Halsey & Co.

Trade Publications.

AUTOMATIC FEED PUMP.—An automatic feed pump and receiver is described in Bulletin B 81, issued by the Geo. F. Blake Manufacturing Company, of 114 Liberty Street, New York City. This apparatus is arranged to automatically pump water of condensation directly back to the boilers and is used for draining steam coils, radiators, heaters, drying cylinders, steam jackets, etc.

WESCO TELEPHONES.—The Wesco Supply Company, St. Louis, Mo., in a recently-issued pamphlet gives some facts concerning the construction of its telephone apparatus, which it, with confidence, invites telephone buyers to think over. The description of the apparatus will enable every purchaser to know what he is buying. The transmitter, induction coil, receiver, ringer movement, gongs, lightning arrester, hook-switch, generator, etc., are all briefly described as to construction, and these parts and complete telephones are well illustrated.

THE WILLIAMS GAUGE COMPANY, 543 Fourth Ave., Pittsburg, Pa., in describing its steam economizing specialties in a bulletin recently issued brings forward some convincing proofs of the merits of its apparatus. Facsimiles of numerous "repeat" orders received from many of the best-known steam users in the country give assurance of satisfaction on all sides. It is stated that the Williams feed-water regulator is now in use in more than 1000 plants, the boilers of which aggregate about 1,250,000-hp in capacity. A number of the factories in which the regulator is used are illustrated and described.

A USEFUL CALENDAR.—The National Carbon Company, Cleveland, Ohio, has gotten out a calendar for 1905 which will be found exceedingly useful in electric light stations. The time of the rising and setting of the sun and moon accompanies each date, and at the right of each monthly sheet is a lighting schedule for the month, giving the time to light-up and extinguish the lights; the number of hours of light per night and total for the month. Alternating with the monthly calendar sheets are others containing information about the company's products. The calendar is attractive as well as useful. The attraction consists of a photograph of a beautiful girl mounted on the card.

WEBER GAS & GASOLINE ENGINE CO., Kansas City, Mo., has just issued a comprehensive bulletin devoted to Weber gas engines and producer plants, and giving a theoretical discussion of the relative economies of steam and producer gas power plants. The fuel given the preference for producer plants is charcoal, because of its light weight for transportation and low cost per thermal unit available. The method of manufacture of charcoal is described in detail. Copies of letters received by the company from users of its system show that the cost of fuel for the gas producer plant is frequently not more than 20 per cent. of that for the steam plant which it replaced.

SPRAGUE ELECTRIC COMPANY, 527 West 34th St., New York, devotes Bulletin No. 505 to flexible steel-armored hose for steam or compressed air. This new type of hose is built of high-grade rubber closely covered with an exterior metal armor composed of interlocking strips of galvanized steel wound spirally in such a manner as to give extreme flexibility. It is stated that a three-ply hose thus armored will stand a hydraulic pressure of 2000 pounds. The bulletin contains a number of half-tones showing the hose in use attached to steam and compressed-air drills and to compressed air chippers. The hose has already been illustrated in ELECTRICAL WORLD AND ENGINEER.

THE DIEHL MANUFACTURING COMPANY, Elizabethport, N. J., devotes bulletin No. 100 to types D and E motors, which have been designed for service where they may receive the minimum amount of expert attendance. These motors are small multipolar machines, exceedingly compact and symmetrical in appearance. In their construction, particular attention has been paid to details, as well as to high efficiency, low heat limits and sparkless operation at all loads up to 25 per cent. overload without change in the position of the brushes. In the bulletin are shown several applications of the Diehl motors for special purposes, such as driving exhaust fans and hydraulic pumps.

ELECTRIC HEATERS.—In a well-arranged pamphlet, the Gold Car Heating & Lighting Company, of 17 Battery Place, New York, presents the merits of the Gold improved electric heaters and other apparatus for warming elevated, suburban, underground or street railway cars. Prominent features of the Gold electric heaters are the provision for the free circulation of the heated air, and the supports used for the resistance coils. The support is made from a steel rod, crimped just enough to hold all of the turns of wire very rigidly. After being corrugated, it is thoroughly covered with an insulating enamel, applied by special process and burned on the surface at a temperature of 2000° F. It is stated that during the past eight years not a single instance has been recorded where this insulation failed to render entire satisfaction.

MODERN HYDRO-ELECTRIC POWER STATIONS.—The second edition of the catalogue thus designated, as issued by J. W. Rickey, civil and hydraulic engineer, of 508 S. First St., Minneapolis, Minn., has recently made its appearance. The catalogue gives details of the concrete-steel type of penstock construction, which is well adapted to the modern power house and pulp mill. This construction was used in the power house of the Lake Superior Power Company, Sault Ste. Marie, Mich., where there are 81 penstocks in one building. It is stated that the saving in cost exceeded $2,000 per unit or $162,000 as compared with masonry. It is claimed that this type of construction will show in any case a net saving of from 10 to 25 per cent. of the cost of the power house, exclusive of machinery, and will produce results far superior to masonry penstocks as heretofore built.

DRILL-GRINDERS.—From the Washburn shops of the Worcester Polytechnic Institute, of Worcester, Mass., has recently been sent forth an illustrated catalogue designated as C, devoted to the recent improvements in Worcester drill-grinders. The manufacture of these grinders was begun in the Washburn shops in 1887, due to the pressing need at that time for some method to supersede the practice of grinding drills by hand, in the attempt to produce which there had been many failures, because the problem was an extremely difficult one. The Worcester drill-grinders are now supplied in any style for any service—a floor or a bench machine for grinding right-handed or left-handed drills, for dry grinding or for wet grinding. The catalogue treats in a logical way of the features necessary to embody in a correct drill-grinder, and describes in detail the various forms which have been produced to meet the requirements.

AUTOMATIC REFRIGERATION.—We have received a copy of a catalogue issued by the Automatic Refrigerating Company, 22 Thames Street, New York, on its system of automatic refrigeration. This system is mechanical and entirely automatic in its action, and any desired low temperature, it is stated, may be uniformly maintained in any properly constructed refrigerator or compartment. The company manufactures and installs complete automatic plants from one-hp. to ten-hp. capacity, or the equivalent of 800 to 12,000 lbs. of ice refrigeration per day. The apparatus, as shown by the illustration, is comparatively simple. Since this system is automatic the services of an engineer are dispensed with. Another advantage is that the compressors are usually driven by electric motors, either direct-connected, belted or geared. Plants of this character would seem to offer a new field for a day load for for central stations.

GISHOLT TOOLS.—As an indication of the trend of progress in the design of machine tools may be mentioned the fact that the Gisholt Machine Company, Madison, Wis., make provision for electric motors on their latest type of milling machine even when they are intended initially to be driven by belt. Electric motor drive may be adopted in the first instance, or a change may be made subsequently at a minimum expense. The most radical departure from former standards of construction is the friction, back-geared headstock with which the operator, standing in his usual position, may instantly start or stop the machine or obtain any of the numerous changes of speed available through it. This form of headstock requires but a single pulley for the drive, thus obviating the belt shifting and variations in belt pull that accompany the use of a cone pulley. These machines together with other Gisholt tools are attractively presented in a loose leaf catalogue recently issued.

News of the Trade.

THE ALBERGER CONDENSER COMPANY, of 95 Liberty Street, New York, has recently opened a branch office in the Home Insurance Building, 205 La Salle Street, Chicago, in order to handle satisfactorily its increasing business in the West.

THE BURKE ELECTRIC COMPANY, lessee of the Keystone Electric Company, has moved its New York office from 114 Liberty Street to 26 Cortlandt Street, where it has on exhibition some of its latest type motors. Mr. H. B. Coho is in charge of the eastern sales office.

THE TRAY PLATE BATTERY COMPANY, of Binghamton, N. Y., has established a New York office at 39 Cortlandt Street, New York, which will be in charge of Mr. H. B. Oakman. The business of the company has grown to such an extent that it felt the necessity of a permanent New York representation.

THE F. BISSELL COMPANY.—In our issue for March 4, 1905, in referring to a compact switchboard recently installed in Kansas City, the address of the makers, the above named company, was erroneously given as Cleveland, instead of Toledo, Ohio. This company has recently issued a switchboard handbook, called "Quotations on the Spot," which differ from most others because in it can be found a description of just what one wants and what it will cost without waiting and writing for an agent or a quotation.

ALTERNATING CURRENT CEILING FANS.—The Hunter Fan & Motor Company, Fulton, N. Y., is offering this year not only the well-known Tuerk alternating current ceiling fans, but also two new types known as the Hunter fan and the Fulton deflector fan. The former fan is so arranged that it can be made very easily into an electrolier. The Fulton fan, which is a distinctly new departure, employs an induction motor and the air is delivered on stationary discs which distribute it equally over a large area. This fan can also be made in electrolier form.

THE NATIONAL ACME MANUFACTURING COMPANY, of Cleveland, O., announces the consolidation of its New York and Philadelphia offices with location at 95 Liberty Street, New York, under the management of Mr. L. M. Waite, formerly in charge of its Philadelphia office, with Mr. S. G. Goodrich as assistant. These gentlemen will attend to Eastern inquiries and orders for "Acme" automatic multiple spindle screw machines, "Acme" screw slotters, semi-automatic, cap screws, set screws, special screws and parts milled from the rod or bar, and other products of the company.

THE CENTRAL ELECTRIC COMPANY, Chicago, reports that the large increase in the sales of Okonite and Manson tapes indicates a growing demand for these exceptionally high-grade tapes, which are made only in one quality—the best. It advises that in order to make a perfect insulation, all wire joints should be taped, first with Okonite rubber tape and second with Manson friction tape. Okonite tape is thoroughly waterproof and a perfect insulating medium. It is not injured by exposure to weather, does not deteriorate when submitted to extreme changes in temperature, and is not affected by commercial acids or alkalies, qualities which the Central Electric Company claims are not possessed by any other tape in the market.

THE GAS & ELECTRIC DEVELOPMENT COMPANY has been organized with offices at 1328 Chestnut Street, Philadelphia, and 82 Beaver Street, New York. The business of the company includes the following: To act as broker in the purchase and sale of electric light and power plants, electric railways, water works and gas plants; to make examinations and furnish reports on the physical and financial condition of such properties; to act as consulting engineer in connection with the construction and repair of properties of this kind; to undertake the operation and management of such properties under special agreements. The officers of the company are: President, Mr. Harry C. Case; vice-president and engineer, Mr. A. B. Beadle; secretary and treasurer, Mr. W. W. Levering. All of these gentleman have had a wide experience in connection with the operation and management and sale of public service properties.

MILWAUKEE OFFICE BUILDING EQUIPMENT.—The Wells Building Company, of Milwaukee, has contracted with the Allis-Chalmers Company for the complete unit of its new power plant, consisting of one vertical cross-compound Reynolds-Corliss engine, direct-connected to a 500-kw Bullock, direct-current generator, engine type. The cylinders of the engine are to be respectively 24 and 40 inches in diameter, with a 36-inch stroke. There will be two eccentrics for each cylinder, one for the steam valves and one for the exhaust valves, both of which are to be double ported. With 145 pounds steam pressure, running at 100 r. p. m., this engine will develop 700 hp, the consumption of dry steam not to exceed 20 pounds per hour. It is guaranteed to be capable of running continuously with an overload of 50 per cent. Allis-Chalmers Company furnished the apparatus for the existing plant of this company, which has given excellent satisfaction.

Weekly Record of Electrical Patents

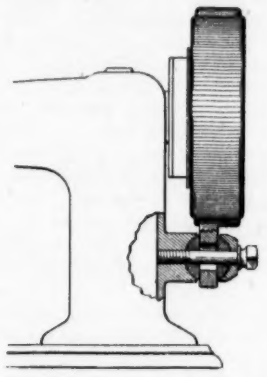
UNITED STATES PATENTS ISSUED MARCH 14, 1905.

[Conducted by Rosenbaum & Stockbridge, Patent Att'ys, 140 Nassau St., N. Y.]

784,529. TELEGRAPHIC TRANSMITTER; Martin Armstrong, St. Louis, Mo. App. filed Dec. 29, 1902. For the transmission of telegraphic signals by means of a typewriting machine having the usual reciprocating keys and means for producing a signal upon the excursion in one direction and for cutting out the circuit on the opposite excursion.

784,547. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES OR MOTORS; John F. Card, Three Rivers, Mich. App. filed Oct. 1, 1903. Relates to details for brush holders.

784,555. JUNCTION BOX FOR ELECTRICAL CONDUCTORS; John Fountain, Jr., Elizabeth, N. J. App. filed Nov. 13, 1902. Details in insulating junction boxes.



784,680.—Sewing-Machine Motor Attachment.

784,557. TELEPHONE CALL; Peter T. Geyerman, Brewster, Minn. App. filed April 29, 1904.

784,588. PARTY LINE SELECTIVE SYSTEM; Frank P. O'Conor and Frederic McNeill, Lasalle, Ill. App. filed Feb. 13, 1904.

784,605. TELEPHONE OPERATOR'S KEY; Louis William Wanemaker, Genoa, Ill. App. filed May 11, 1904.

784,635. RELAY; Michael Setter, Chicago, Ill. App. filed April 5, 1902. The armature of the relay is so mounted that its resistance to movement increases as it moves toward the magnet and has very little resistance in its initial movement.

784,639. ELECTRICAL TROLLEY; Seneca R. Stoddard, Glens Falls, N. Y. App. filed March 21, 1903. The trolley shoe has a member mounted therein capable of lateral movement, which may be by gravity, for engaging an electrical conductor.

784,649. ADVERTISING APPARATUS; Willis B. Worthy, Chicago, Ill. App. filed Nov. 3, 1904. Advertising signs are equipped with electric lights and a series of switches provided whereby a railroad train approaching the advertising sign will turn on the lights, and after it has passed, will turn off the light, thus giving the illumination to the sign during such times only as trains are in the vicinity.

784,678. TROLLEY CATCHER AND RETRIEVER; William W. Hoffman and Francis W. Powers, West Lafayette, Ind. App. filed Sept. 23, 1904. Details of construction.

784,680. SEWING MACHINE MOTOR ATTACHMENT; Francis P. Huyck, Swanton, Ohio. App. filed June 4, 1903. The armature occupies the place of the balance wheel on the sewing machine and the field magnets are supported by a universal connection with the sewing machine head and clamped in position by means of a single set screw.

784,681. TROLLEY GUIDE; John F. Jameson, Plimton, Ohio. App. filed Dec. 21, 1904. Framework for holding the trolley wheel to the wire at curves, etc.

784,695. INSULATING LINING; Norman Marshall, Newton, Mass. App. filed April 15, 1903. Insulating lining particularly adapted for use in lamp sockets. The lining has a portion of larger diameter than the parts of the shell or socket within which it is to fit, so that this portion will be compressed when inserted.

784,712. ELECTRIC CENTRAL STATION RECORDING MECHANISM FOR METERS; Chester H. Thordarson, Chicago, Ill. App. filed Oct. 28, 1903. (See Current News and Notes.)

784,713. ELECTRIC METER RECORDING MECHANISM; Chester H. Thordarson, Chicago, Ill. App. filed Oct. 28, 1903. (See Current News and Notes.)

784,718. ELECTRIC SOLENOID; Ludwig S. Walle, Brooklyn, N. Y. App. filed Dec. 29, 1903. The windings for the coil of the solenoid are interrupted at given distances along the length of the coil and these connected up so that as the core is drawn into the coil the portion of the coil behind the core will be cut out and the portion immediately in front of it cut into circuit, thus giving a long travel to the core and saving current.

784,720. TELEPHONE SIGNALING MEANS; Klas Weman, New York, N. Y. App. filed June 4, 1904.

784,722. AUTOMATIC CIRCUIT BREAKER; Earl P. Wetmore, Wolverhampton, Eng. App. filed Oct. 22, 1903. Embodies means for delaying the resetting action and positively locking the resetting devices, so long as a short circuit remains on the line protected by the circuit breaker.

784,732. SYSTEM OF ELECTRICAL DISTRIBUTION; Rufus N. Chamberlain, Depew, N. Y. App. filed June 12, 1903. Details of power station distribution.

784,741. INSULATED RAIL JOINT; George L. Hall, New York, N. Y. App. filed Jan. 9, 1904. Details of construction.

784,766. ELECTRIC CONDUCTOR UNION; Frederick W. Sorg, Englewood, N. J. App. filed Aug. 17, 1903. A U-shaped sheet metal sheath having internal projections to form a wire retaining pocket for one of the wires and having projecting edges above such pocket for receiving the other of the wires, which wires may, when placed in the sheath and the edges bent over upon the second wire, be twisted together.

784,775. LAMP SOCKET; Henry Bayer, Schenectady, N. Y. App. filed June 21, 1901. Details of construction.

784,799. WINDING FORM; Julius W. Lundskog, Lynn, Mass. App. filed Feb. 6, 1903. Form on which coils having the wire laid on in layers may be made.

784,807. DYNAMO ELECTRIC MACHINE; Henry G. Reist, Schenectady, N. Y. App. filed Aug. 1, 1904. An arrangement for squirrel-cage windings which enables them to exhibit to a certain degree at starting the characteristics of a coil-wound armature with resistance in circuit, and at full load to operate like an ordinary squirrel-cage armature.

784,814. RAILWAY MOTOR CONTROL; Charles P. Steinmetz, Schenectady, N. Y. App. filed Aug. 20, 1904. System by means of which electric motors may be operated on either alternating or direct current. (See Current News and Notes.)

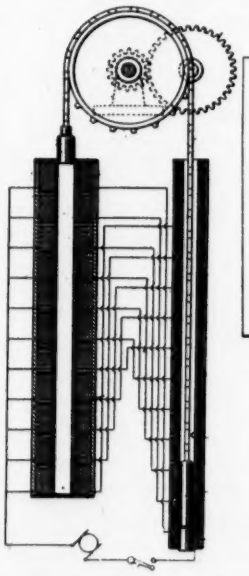
784,843. TROLLEY; Michal O. Day, Newcastle, Pa. App. filed Dec. 20, 1904. The harp is rotatably mounted within a shell and springs are employed for returning the harp to its normal position when out of alignment with the wire.

784,858. COMBINED TYPEWRITER AND TELEGRAPH TRANSMITTER; Cyrus H. Hepinstall, St. Thomas, Can. App. filed Feb. 1, 1904. The electric transmitting mechanism is connected with a typewriter of usual construction and may be quickly engaged or disengaged therefrom, in connection with means for throwing the transmitter in or out of connection while still in engagement with the typewriter and for simultaneously closing the telegraph circuit so that messages may be received and recorded on the typewriter.

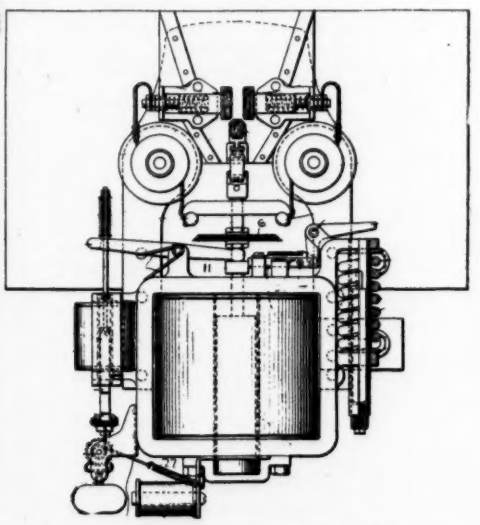
784,860. TRAINGRAPH; William A. Inwood, Colorado Springs, Colo. App. filed Aug. 16, 1904. Continuous main line conductors are employed to permit telegraphing to be carried on between a station and a railway car or vehicle or between stations, etc. The two conductors are insulated one from another and extend continuously along the railway.

784,865. ELECTRIC TRAIN SIGNALING EQUIPMENT; W. Britton Lane, Evanston, Ill. App. filed Dec. 21, 1904. Involving a pair of parallel relatively higher and lower rail lines, between and parallel with the track rails.

784,869. ELECTRIC ELEVATOR CONTROL; Nils O. Lindstrom, Jersey City, N. J. App. filed Nov. 17, 1904. This system provides for mechanism for controlling an elevator so that after one would-be passenger has pushed a button to bring the car to him, another cannot interfere with the movement of the car in any manner until the first passenger has obtained the car, moved thereon to his destined floor, passed out of the car and finally closed the shaft door behind him, thus providing a perfectly safe system of push button control.



784,718.—Electric Solenoid.



784,722.—Automatic Circuit-Breaker.

784,872. RELAY; Ray H. Manson, Chicago, Ill. App. filed Aug. 3, 1903.

784,928. RAIL JOINT; William Daves, Bloomington, Ill. App. filed Nov. 23, 1904. Details of construction.

785,004. ELECTRIC MOTOR; Rudolf Klemm and Felix Reiss, Berlin, Germany. App. filed May 26, 1904. Details of construction of electric motor for light work.

785,026. ELECTRIC OPEN SWITCH AND STOP SIGNAL; John B. Smiley, South Omaha, Neb. App. filed Dec. 14, 1904. Details of construction.

785,031. BLOCK SYSTEM; John W. Anderson, Jr., Woodland, Ill. App. filed Dec. 26, 1903. The semaphore in this system is operated by mechanism including a motor, a motor circuit, a revolvable disk connected to the motor and the semaphore arm and means in part controlled by the disk for making and breaking the motor circuit.

785,056. VIBRATOR REGULATOR; Charles F. Splitdorf, New York, N. Y. App. filed Jan. 23, 1904. A spring-controlled ball engages notches upon a hub on the regulator screw for holding the same in position.

12,324. TROLLEY WHEEL GUARD FOR ELECTRIC WIRES; John L. Sullivan, Warren, R. I. App. filed Jan. 26, 1905. The harp in addition to the trolley wheel, carries a pair of transversely disposed wheels for engaging the upper surface of the wire and in connection with this there are means for opening the harp, together with other details of construction.